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Pictured above is one of the 50-ton Whitcomb Timken-equipped oil-electric switching units in use on the Milwaukee Road.

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August - 1931

Four Test Locomotives For the Baltimore & Ohio

The Baldwin Locomotive Works builds two 4-8-2 types and two 2-6-6-2 types for test in passenger and freight service—One of each type is equipped with the Emerson water-tube firebox —The new articulated power was designed by the railroad for service over all parts of the main line of the system

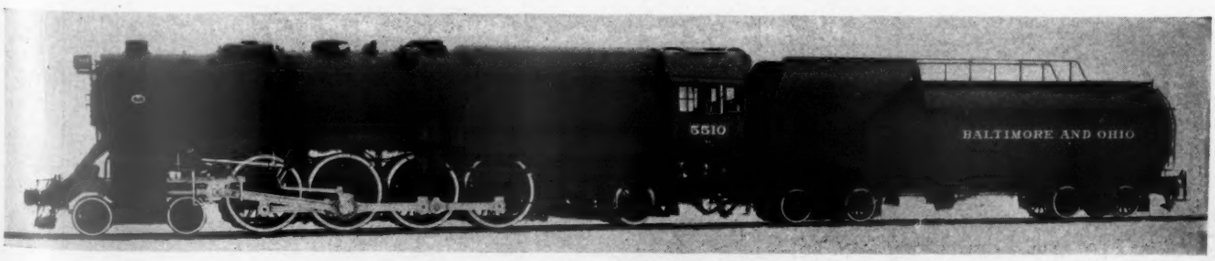
FOUR locomotives, two of the 4-8-2 type and two of the 2-6-6-2 type, were delivered to the Baltimore & Ohio in December, 1930, and January, 1931, for comparative tests in actual service over certain heavy-tonnage districts on the system. One each of the two types of locomotives are equipped with the Emerson water-tube firebox. The 4-8-2 type so equipped is known as the Class T-1, and the 2-6-6-2 type with the water-tube firebox has been assigned the classification KK-1. The 4-8-2 type built with the conventional stayed firebox is known as Class T-2, while the 2-6-6-2 type of conventional boiler construction is designated Class KK-2.

As shown in one of the tables, the two locomotives of the same type have essentially the same weights and dimensions. Locomotives Classes T-1 and T-2 develop a tractive force of 65,000 lb. They have 74-in. driving wheels and 27½-in. by 30-in. cylinders. The boilers operate at a pressure of 250 lb. Locomotives Classes KK-1 and KK-2 have a rated maximum tractive force of 90,000 lb. and operate at a boiler pressure of 250 lb. They have 70-in. driving wheels and four 23-in. by 30-in. cylinders.

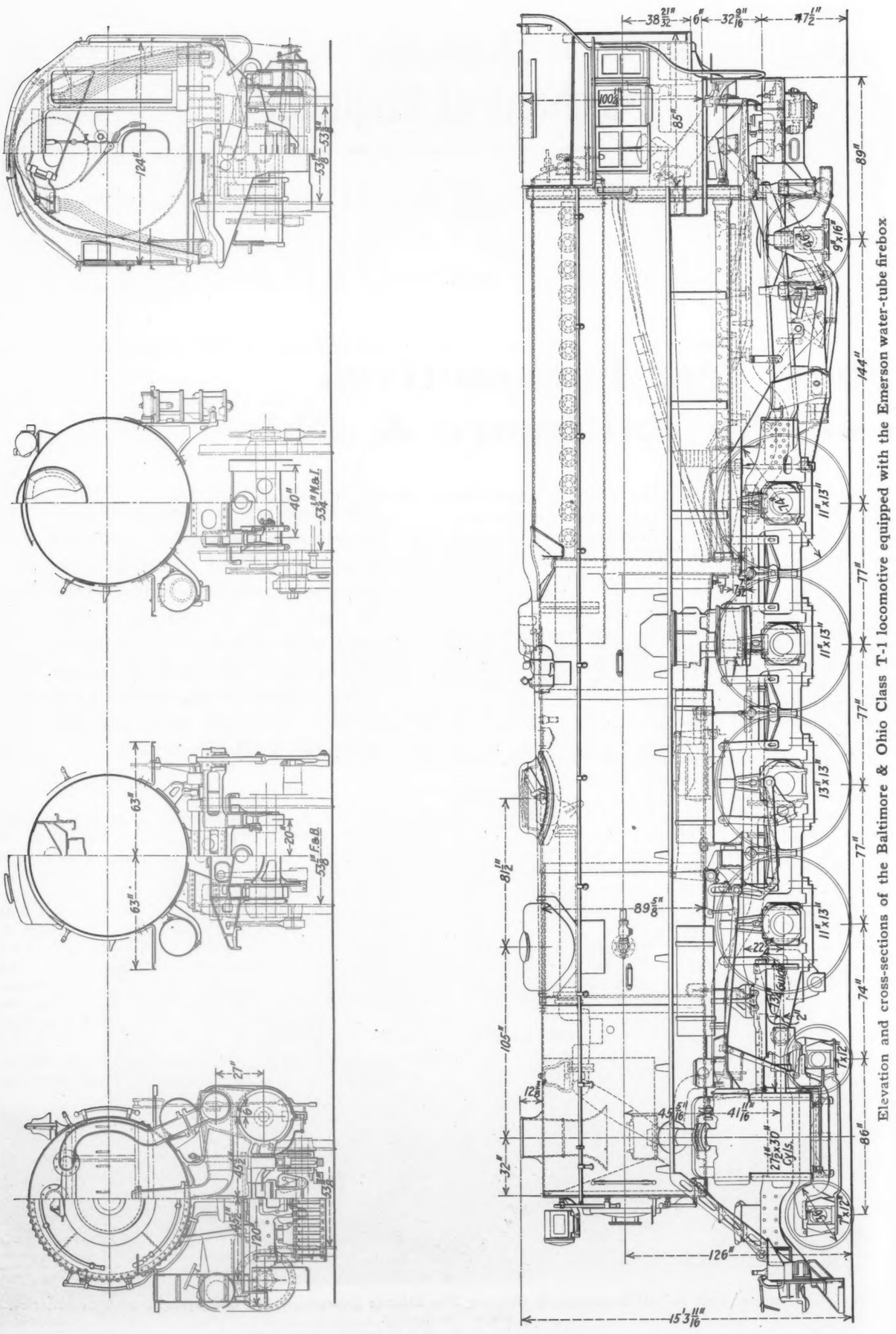
Several districts on the Baltimore & Ohio are served with either heavy 2-8-0 type locomotives or light 2-8-2 type locomotives on account of a number of bridge limitations, especially west of Grafton, W. Va. The 2-8-0 type locomotives have a tractive force of 50,900 lb. and the 2-8-2 types from 51,000 lb. to 56,000 lb. The Class Q-laa of the latter type generally used in that district, with 223,600 lb. on the drivers, are the heaviest locomotives permitted with the driving wheels spaced from 5-ft. 5-in. to 5-ft. 10-in. It is frequently necessary in order to move the tonnage in these districts to double-head the 2-8-0 and 2-8-2 type locomotives, with resultant high operating cost.

Considering the above points and also the fact that the cost to strengthen or rebuild all the structures to suit heavier and more powerful locomotives, such as the heavy 2-8-2 and 2-10-2 types, would be prohibitive and require a number of years, it was decided that it would be more economical to design new power. This resulted in the purchase of the KK-1 and KK-2 locomotives.

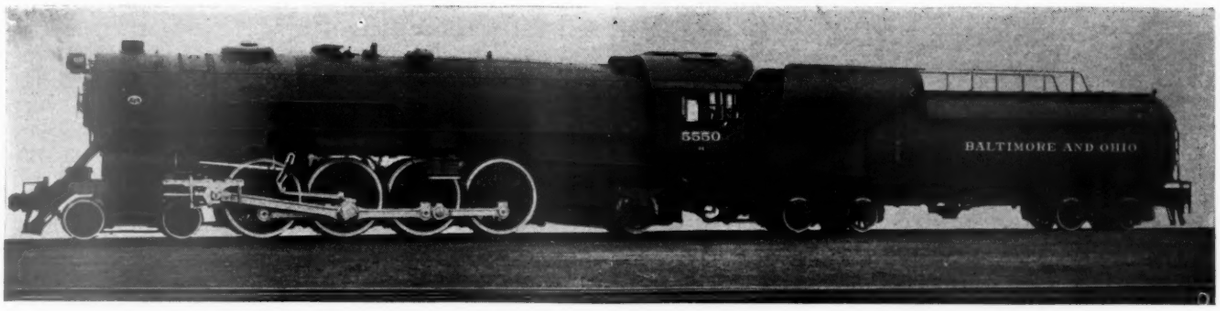
In the development of the design of the two articulated locomotives a careful study and comparison was



Class T-1 locomotive built for the Baltimore & Ohio by The Baldwin Locomotive Works—Equipped with the Emerson water-tube firebox



Elevation and cross-sections of the Baltimore & Ohio Class T-1 locomotive equipped with the Emerson water-tube firebox



Class T-2 locomotive built with the conventional stayed firebox

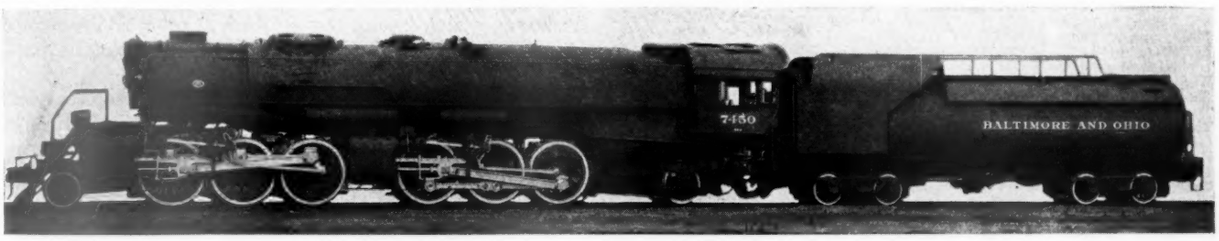
made of the design and performance of various types of locomotives already in service on the Baltimore & Ohio. The principal weights and dimensions of the types included in the study are shown in one of the tables. This study showed that a high-wheel light 2-6-6-2 single-expansion articulated locomotive with a tractive force of 90,000 lb. would meet the requirements. In addition, it was estimated that a locomotive of this design could be more economically used in the territories over main-line tracks where the heavy 2-8-2 and 2-10-2 types are used, because of the increased capacity and speed of the articulated power. The KK class locomotives can be operated anywhere on the Baltimore & Ohio lines between New York and Chicago, and East St. Louis, Ill. This includes the Reading and the New Jersey Central lines over which the Baltimore & Ohio operates to New York.

The 4-8-2 Types for Passenger and Fast-Freight Service

There is also some territory on the Baltimore & Ohio, especially between Washington, D. C., and New Castle Junction, Pa., that is now served with heavy stoker-fired 4-6-2 type passenger locomotives. However, with trains of over eight cars it is necessary to use helper service over mountain grades. To handle important passenger trains over the grades without a helper and also to meet weight and clearance limitations as well as operating schedules, the T-1 and T-2 class 4-8-2 type locomotives were designed. These locomotives have sufficient flexibility to meet the requirements described and to be used on the main line between New York and Chicago, and Grafton, W. Va. They are also suitable for handling fast-freight trains which are now handled by 2-8-2 type locomotives of the Q-4 class having 64-in. drivers.

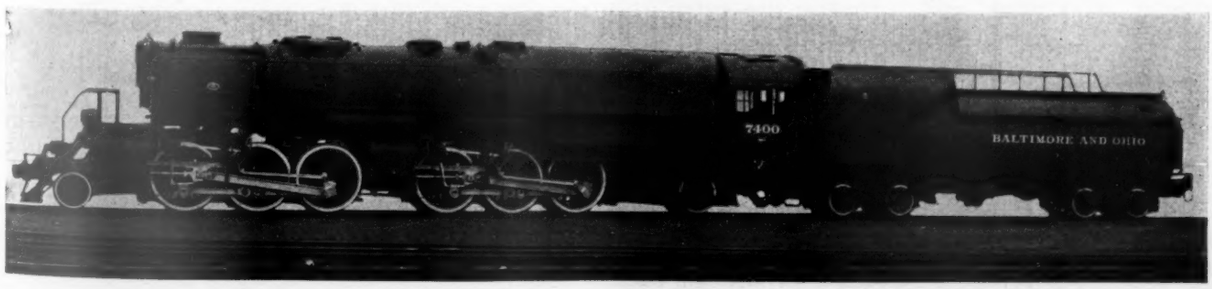
General Design and Construction of the Four Locomotives

The T-1 and T-2 class locomotives were designed to meet weight limitations of around 658,000 lb. With this limit, tenders with a capacity of 18,000 gal. of water and 20 tons of coal were found to be practicable. Comparisons of these two classes of locomotives with the Classes P-1d, Q-4 and T are also shown in the table on page 402.

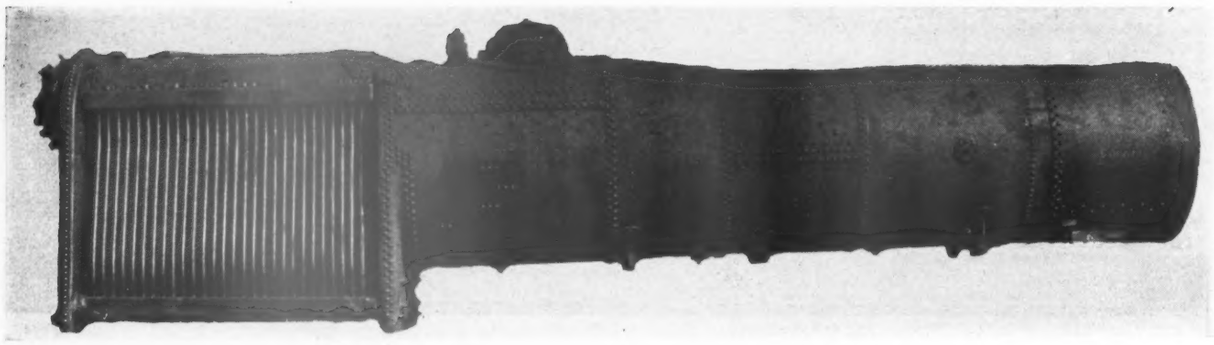


Class KK-2 single-expansion articulated locomotive

The Classes T-1 and T-2 and also Classes KK-1 and KK-2 locomotives, respectively, are identical with the exception of the firebox and some of the boiler details. The two locomotives equipped with the Emerson water-tube fireboxes have Type A superheaters, while the two with the fireboxes of customary staybolt construction have two Thermic syphons and Type E superheaters. Other equipment applied to all four locomotives include Sellers exhaust-steam injectors, Lower stokers, power reverse gears, General Steel Castings Company cast-steel cylinders, and General Railway Signal train-control



Class KK-1 single-expansion articulated locomotive built with the Emerson water-tube firebox



Side view of boiler equipped with the Emerson water-tube firebox

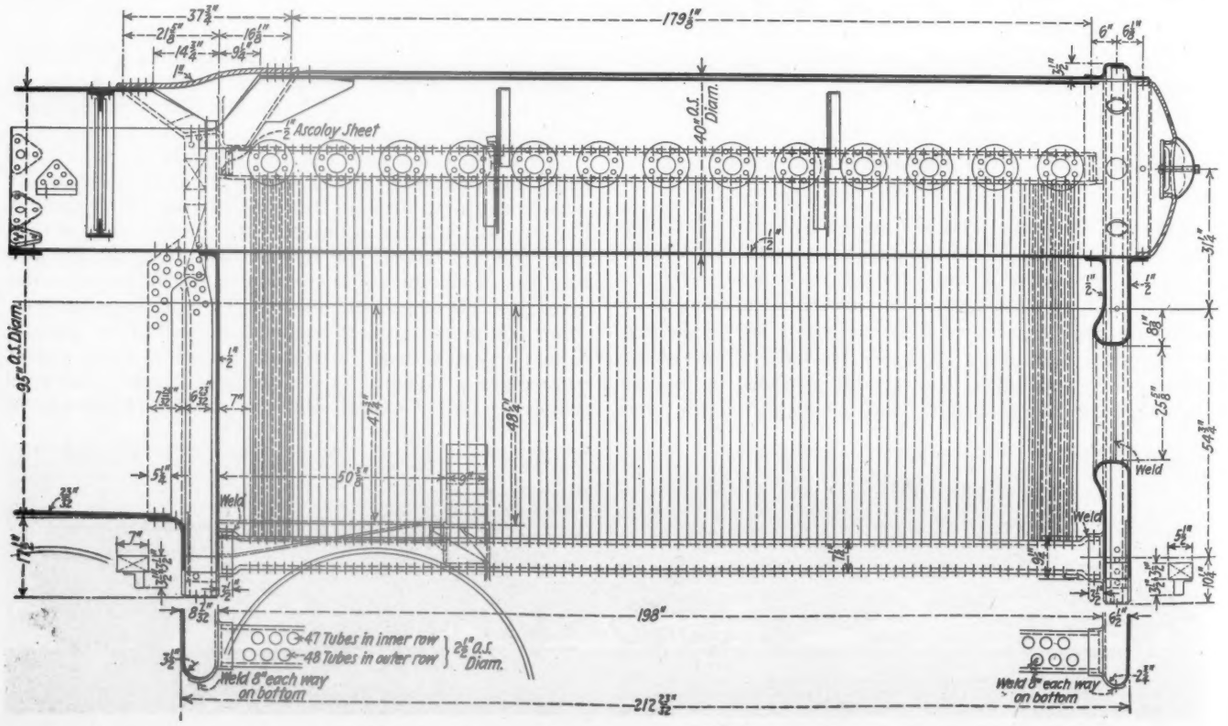
equipment. During the period of the test an Elesco exhaust-steam injector was applied to locomotive No. 5510, Class T-1, and is still applied. Three locomotives, Classes T-1, KK-1 and KK-2, have the Barco power reverse gear, while locomotive No. 5550, Class T-2, is equipped with the Precision gear. A list of the special equipment and appliances on locomotive No. 7400 is shown in one of the tables. The items included in this list are practically the same as applied on the three other locomotives with the exceptions noted.

Average Results of Dynamometer-Car Tests Between Keyser, W. Va., and Brunswick, Md., with Locomotive No. 7400

Number of tests run	3
Season of tests	Winter
Train consist:	
Number loads	96
Number others	1
Total number cars	97
Actual tonnage	8,245
Total time en route	5 hr. 49.6 min.
Road delays	0 hr. 36.4 min.
Net running time	5 hr. 13.2 min.
Average speed, m.p.h.	20.91
Number of stops	3
Total coal as fired	31,500 lb.
Total water evaporated	27,204 gal.
Coal as fired per 1,000 gross ton-miles	35.14 lb.
Coal as fired per sq. ft. grate area per hr.	86.82 lb.
Evaporation, water per lb. coal as fired	7.20 lb.
Coal per drawbar horsepower-hour, as fired	3.14 lb.
Water per drawbar horsepower-hour, actual	22.59 lb.
Average drawbar horsepower	2,546
Average drawbar pull	47,951 lb.
Average boiler pressure, lb. per sq. in.	246.2
Average steam-chest pressure, lb. per sq. in.	216.3
Average back pressure, lb. per sq. in.	3.7
Average cut-off, per cent	42.8
Maximum steam temperature, deg. F.	610
Average B.t.u. per lb. coal as fired	12,994
Per cent moisture in coal as fired	1.74
Overall thermal efficiency at drawbar, per cent	6.25
Pusher used for 8.2 miles over maximum equated grade of	0.85 per cent

The Emerson water-tube fireboxes on the Classes T-1 and KK-1 are designed with a single drum. While different in some details from other designs of water-tube fireboxes which have been applied to other Baltimore & Ohio locomotives, they are designed on the same basic principles.

The preliminary plans for the four locomotives were prepared by the mechanical department of the Baltimore & Ohio, while the details of construction as affecting weight limitations were handled jointly by the builder and the mechanical department of the railroad. The necessity of minimum weight combined with strength



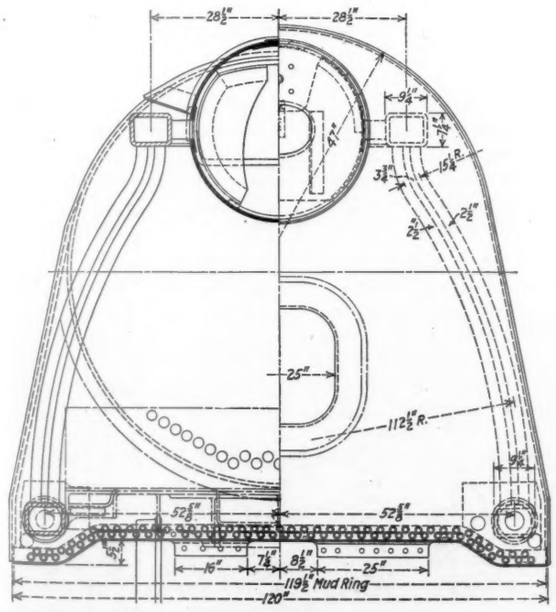
Side elevation of the Emerson water-tube firebox

of parts made it advisable to employ nickel-steel plate in the construction of the boiler shell with special "saw-tooth" butt seams, cast-steel cylinders, single-bar guides, and hollow axles and crank pins. The frames, crossties and bracing members are welded together, practically eliminating the use of joint bolts in the building of the frame structure.

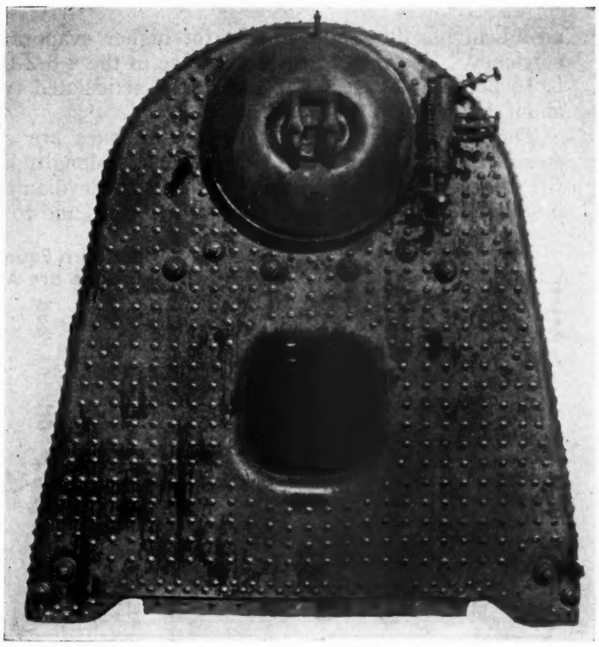
Straight-line running boards and a neat piping arrangement have materially assisted in producing handsome machines. Neatness and convenience have been carried into the back-head and cab arrangement. The cab is of the semi-vestibuled type and provides a seat for the head brakeman. Permanent back doors are provided for entrance, leaving a minimum open space at the center which in winter weather can be protected by a curtain.

List of Special Parts, Appliances and Equipment Applied on the Baltimore & Ohio 2-6-6-2 Type Locomotive No. 7400

Railroad	B. & O.
Service	Freight
Boiler and firebox:	
Blow-off cock	Bird-Archer
Blow-off cock, auxiliary	Coale
Boiler jacket	Bethlehem Steel
Fire brick	Security
Firedoor	Franklin butterfly
Injector, Exhaust steam	Elesco
Injectors and injector check	Sellers
Lagging	Philip Carey
Smokebox hinges	Okadee
Staybolts	Ewald
Stoker	Lower
Superheater	Type A
Tubes and flues	National Tube
Valve, blow-off	Bird-Archer
Valves, safety	Coale
Valve, throttle	Chambers
Washout and arch-tube plugs and bushings	Huron
Cylinders and running gear:	
Bullring, packing and piston head	Locomotive Finished Material
Cradle	General Steel Castings
Driving axles	Standard Steel
Driving boxes	Grisco
Frames, engine- and trailer-truck	General Steel Castings
Lubricators, force-feed	Nathan
Packing, piston-rod and valve-stem	U. S. Metallic
Reverse gear	Barco
Rods, main and side	Standard Steel
Springs, elliptic	Crucible Steel
Valves, blower	Coale
Valves, drain	Okadee
Valves, drifting	Sellers
Valve motion	Walschaert
Wheels, front and back engine-truck	Standard Steel
Cab and miscellaneous:	
Bell ringer	Transportation Devices
Brake equipment	New York Air Brake
Brake shoes	American
Drawbar	Unit Safety
Gage, reflex water	Wiltbonco
Gage, steam	Ashton
Headlight case and generator	Pyle-National
Joints, ball	Barco
Joints, flexible	Barco
Knuckle, emergency	Hynson
Lamps, cab	Pyle-National
Lamps, classification	Armspear
Pipe covering	Insutape
Pipe unions, Dart	Fairbanks
Replacers, car	Buda No. 37
Sanders	U. S. Metallic
Train control	General Railway Signal
Tender:	
Buffer, radial	Franklin
Bumper, back	General Steel Castings
Coal sprinkler	Sellers
Coupler, pilot and tender	National Malleable
Coupler yoke	Buckeye Steel Castings
Draft gear	National Malleable
Frames, truck side	Pittsburgh Steel Foundry
Hose strainers	Sellers
Lamp, back-up	Pyle-National
Truck-box lid	Symington
Wheels	Standard Steel



Cross-section of the Emerson water-tube firebox



Back head of an Emerson water-tube firebox applied to a 4-6-2 type locomotive class P9A at the Mt. Clare shops in 1929

A maximum of interchangeability between the machinery parts of both types of locomotives is provided. Steam distribution is by Walschaert valve motion of light design, the piston valves of which are 12-in. in diameter. The articulated locomotives are limited to approximately 70 per cent cut-off, while in the 4-8-2 type the maximum is 87½ per cent. The main throttle is located in the dome. The drifting valve is operated by compressed air, and cylinder lubrication is by mechanical means.

Feedwater is supplied by an exhaust-steam injector located on the right side and by a live-steam injector on the left side.

The Emerson Water-Tube Firebox

The fireboxes of the conventional boilers are of large volume, with combustion chambers. The radiant heating surface in the 4-8-2 type is about 9 per cent of the total, while in the articulated type this proportion is less than 8 per cent.

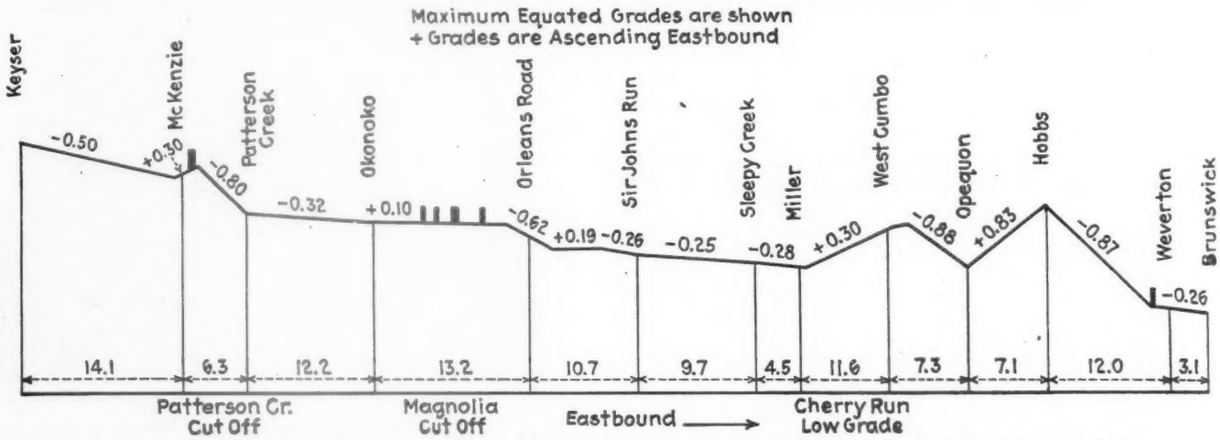
The Emerson water-tube fireboxes of locomotives No. 5510 and No. 7400 considerably increase the ratio of radiant, to convection surface and in this respect show

an advantage that should make for higher evaporative efficiency. The direct heating surface in the 4-8-2 type is 16 per cent of the total and in the articulated type, about 13 per cent.

The boilers with the water-tube fireboxes are constructed with the conventional barrel and longitudinal fire tubes. A single drum, 40-in. in outside diameter, is secured to the back tube sheet at the front, and to the backhead and door sheet at the rear. The back tube sheet is flanged toward the inside to form the riveted connection to the drum, instead of toward the fire side of the sheet. This construction eliminates the double thickness of metal exposed to the radiant heat of the fire. The drum extends rearward and terminates in a bulged head after passing through a back water leg with which it is connected by means of circulating ports. The front water leg is below the drum and is of conventional type as formed by the boiler throat and back tube-sheet.

The front and back water spaces are connected on each side at the bottom with a 5½-in. by 7½-in. seamless rectangular header. Headers of the same size as the top extend along the sides of the drum. The ends of the top headers are blank and have no direct connection with either the back water space or the shell of the boiler.

A total of 190 water tubes, 2½-in. outside diameter, are arranged in two rows between the top and bottom headers. Coarse-thread plugs are located in the top of the top headers opposite the ends of the tubes,



Profile of line between Keyser and Brunswick used for the road tests with the Class KK-1 locomotive

Comparison of Other Baltimore & Ohio Locomotives with the New 4-8-2 and 2-6-6-2 Types Built by the Baldwin Locomotive Works

Railroad	B. & O.	B. & O.	B. & O.	B. & O.	B. & O.	B. & O.	B. & O.	B. & O.	B. & O.	B. & O.
Builder	B. & O.	Baldwin	B. & O.	Baldwin	Baldwin	American	Baldwin	Baldwin	Baldwin	Baldwin
Year built	1924-26	1920-21	1925	1930	1930	1910	1911	1923	1930	1930
Service	Passenger	Passenger	Passenger	Passenger	Passenger	Freight	Freight	Freight	Freight	Freight
Road class	P-1d	Q-4	T	T-1	T-2	E-27ca	Q-1aa	S-1	KK-1	KK-2
Type of locomotive	4-6-2	2-8-2	4-8-2	4-8-2	4-8-2	2-8-0	2-8-2	2-10-2	2-6-6-2	2-6-6-2
Cylinders, diam. and stroke, in.	26½x28	26x32	30x30	27½x30	27½x30	24x30	26x32	30x32	4-23x30	4-23x30
Valve gear, type	Baker	Baker	Baker	Walschaert	Walschaert	Baker	Walschaert	Baker	Walschaert	Walschaert
Vaives, piston type, size, in.	.....	.....	.....	12	12	.....	.....	.....	12	12
Maximum travel, in.	.....	.....	.....	7	7	.....	.....	.....	7	7
Outside lap, in.	.....	.....	.....	1⅛	1⅛	.....	.....	.....	1¾	1¾
Exhaust clearance, in.	.....	.....	.....	⅛	⅛	.....	.....	.....	Zero	Zero
Lead in full gear, in.	.....	.....	.....	¼	¼	.....	.....	.....	7/8	7/8
Cut-off in full gear, per cent	.....	.....	.....	87½	87½	.....	.....	.....	70	70
Weights in working order:										
On drivers, lb.	200,000	247,000	275,000	260,000	260,000	202,900	223,600	347,230	372,000	373,000
On front truck, lb.	55,000	22,700	62,000	61,000	62,000	22,000	18,400	31,570	30,000	30,000
On trailing truck, lb.	62,000	57,700	63,000	63,000	63,000	.....	40,200	57,710	63,000	63,000
Total engine, lb.	317,000	327,400	400,000	384,000	385,000	224,900	282,200	436,510	465,000	466,000
Total engine and tender, lb.	549,000	541,400	669,000	657,000	658,000	372,970	463,700	734,910	738,000	739,000
Wheel bases:										
Driving, ft. in.	13—0	16—9	19—3	19—3	19—3	16—8	16—9	22—4	34—11	34—11
Total engine, ft. in.	34—8	35—1	41—4	44—7	44—7	25—7	35—0	42—11	56—0	56—0
Total engine and tender, ft. in.	76—5 7/8	74—1½	90—7 11/16	92—11¾	92—11¾	59—8½	71—2 9/16	89—10⅞	104—4¾	104—4¾
Wheels, diam. outside tires, in.:										
Driving	74	64	74	74	74	62	64	64	70	70
Front truck	.....	.....	.....	36	36	.....	.....	.....	36	36
Trailing truck	.....	.....	.....	46	46	.....	.....	.....	46	46
Journals, diam. and length:										
Driving, main, in.	.....	.....	.....	13x13	13x13	.....	.....	.....	12x13	12x13
Driving, others, in.	.....	.....	.....	11x13	11x13	.....	.....	.....	10½x13	10½x13
Front truck, in.	.....	.....	.....	7x12	7x12	.....	.....	.....	6½x12	6½x12
Trailing truck, in.	.....	.....	.....	9x16	9x16	.....	.....	.....	9x16	9x16
Boiler:										
Type	St. Top	St. Top	St. Top	W. T. Fbox.	St. Top	St. Top	St. Top	St. Top	W. T. Fbox.	St. Top
Steam pressure, lb.	225	220	220	250	250	215	190	220	250	250
Fuel, kind	Bit.	Bit.	Bit.	Bit.	Bit.	Bit.	Bit.	Bit.	Bit.	Bit.
Diameter, first ring, inside	78	78	90	89⅝	89⅝	74½	78	90	89⅝	89⅝
Firebox, length and width, in.	120x84	120x84	132¼x96	138x96	138¼x96¼	107⅝x75¼	120x84	132⅛x96	138x96	138⅛x96¼
Combustion chamber length, in.	.....	.....	.....	.....	54	.....	.....	.....	.....	67
Tubes, no. and diam., in.	.....	.....	.....	260—2¼	59—2¼	.....	.....	.....	260—2¼	59—2¼
Flues, no. and diam., in.	.....	.....	.....	52—5½	224—3½	.....	.....	.....	52—5½	224—3½
Length over tube sheets, ft. in.	21—0	20—5	23—0	20—0	21—0	15—10	21—10	23—0	25—0	25—0
Grate area, sq. ft.	70	70	89.17	92	92.3	56.24	70	88	92	92.3
Heating surfaces:										
Firebox and comb. chamber, sq. ft.	228	228	341	783	361	179.3	228	347	783	383
Arch tubes, sq. ft.	28	35	42	83	18	.....	.....	42	83	18

Road class	P-1d	Q-4	T	T-1	T-2	E-27ca	Q-1aa	S-1	KK-1	KK-2
Thermic syphons, sq. ft.					95					95
Total radiant	256	263	383	866	474	179.3	228	389	866	496
Tubes and flues, sq. ft.	3,706	3,550	5,208	4,537	5,015	2,213.4	3,708	4,881	5,677	5,975
Total evaporative, sq. ft.	3,962	3,813	5,591	5,403	5,489	2,392.7	3,936	5,270	6,543	6,471
Superheating, sq. ft.	859	955	1,305	1,340	2,451	425	811	1,510	1,666	2,900
Comb. superheat. and evap., sq. ft.	4,821	4,768	6,896	6,743	7,940	2,817.7	4,747	6,780	8,209	9,371
Tender:										
Water capacity, gal.	13,500	18,000	18,000	18,000	18,000	7,000	9,500	15,800	18,000	18,000
Fuel capacity, tons	19	17½	20	20	20	18	18½	23	20	20
Rated tractive force, lb.	51,000	63,200	68,200	65,000	65,000	50,900	54,600	84,300	90,000	90,000
Weight proportions:										
Weight on drivers ÷ tractive force	3.92	3.9	4.03	4	4	3.94	4.1	4.12	4.13	4.14
Weight on drivers ÷ total weight engine, per cent	63.2	75.6	68.8	67.8	67.5	90.2	79.1	79.4	80	80
Total weight engine ÷ comb. heat. surface	65.8	68.7	58.2	57	48.5	79.7	59.8	64.4	56.7	49.7
Boiler proportions:										
Tractive force ÷ comb. heat. surface	10.6	13.25	9.9	9.65	8.2	18.1	11.5	12.4	10.95	9.6
Tractive force × diam. drivers ÷ comb. heat. surface	784	848	732	714	606	1,124	739	795	768	673
Firebox heat. surface ÷ grate area	3.66	3.76	4.3	8.51	3.91	3.19	3.26	4.43	8.51	4.16
Firebox heat. surface, per cent of evap. heat. surface	6.46	6.9	6.85	14.43	6.58	7.53	5.8	7.38	11.97	5.92
Superheat. surface, per cent evap. heat. surface	21.6	25.2	23.4	24.75	44.7	42.8	20.6	28.7	25.6	44.7

convenient for rolling in and also for turbining the tubes at washout periods. Construction plugs are used in the bottom of the bottom headers for convenience in rolling in the tubes. However, these plugs are not removed at the time tubes are turbined. The top headers are connected to the drum along each side with a series of 13 short nipples 4-in. in outside diameter. A shallow pressed-steel hip sheet joins the top portion of the drum to the boiler shell. Insulation is applied between the drum and the upper side headers and over the water tubes at the sides.

The water-tube firebox in locomotives Classes T-1 and KK-1 effected a substantial increase in heating surface over the stayed firebox without increasing the weight. For example, the water-tube firebox has an evaporative heating surface of 866 sq. ft. as compared with 474 sq. ft. of evaporative surface for the stayed fireboxes, including the syphons—an increase of 82 per cent. To increase the heating surfaces of the stayed fireboxes to obtain the same heating surface as the water-tube fireboxes, the additional weight would have required a four-wheel trailing truck, and furthermore would have increased the total weight of the locomotive to such an extent as to prohibit operation over a number of divisions. The water-tube fireboxes have large combustion chambers, part of which can be conveniently used for increasing the grate area if desired.

The Tenders

The Vanderbilt type tenders are of light construction, having a tank capacity of 18,000 gal. and a bunker capacity for 20 tons of coal. The frame is combined with the bottom tank sheet. The tender weighs 273,000 lb. loaded; 2.16 lb. of coal and water carried per pound of light tender.

Road Tests of the No. 7400

A series of road tests with a dynamometer car were made with the 2-6-6-2 type locomotive, No. 7400, which is equipped with the Emerson water-tube firebox. These tests were made in slow-freight service eastbound on the east end of the Cumberland division, between Keyser, W. Va., and Brunswick, Md. This is not the operating territory for which the locomotive was designed, but is the division regularly used by the railroad for road tests. The profile of this part of the line, shown on one of the drawings, is especially adapted for road tests. Owing to the fact that other locomotives have been tested over this same line, a comparison with other performances can be readily made.

The distance from Keyser to Brunswick is approximately 112 miles. Between Opequon and Hobbs, a distance of seven miles, there is a ruling grade of .73 per cent with a maximum curvature of 4 deg. Helper service is required between these two points.

The trains hauled during the tests averaged 9,700 adjusted tons. The trains were made up of loaded 50- and 70-ton coal cars. The average results of these tests are shown in one of the tables. Several preliminary runs were made to determine the correct size of nozzles which would properly draft the engine for this service. Two 5½-in. open exhaust nozzles gave the best results.

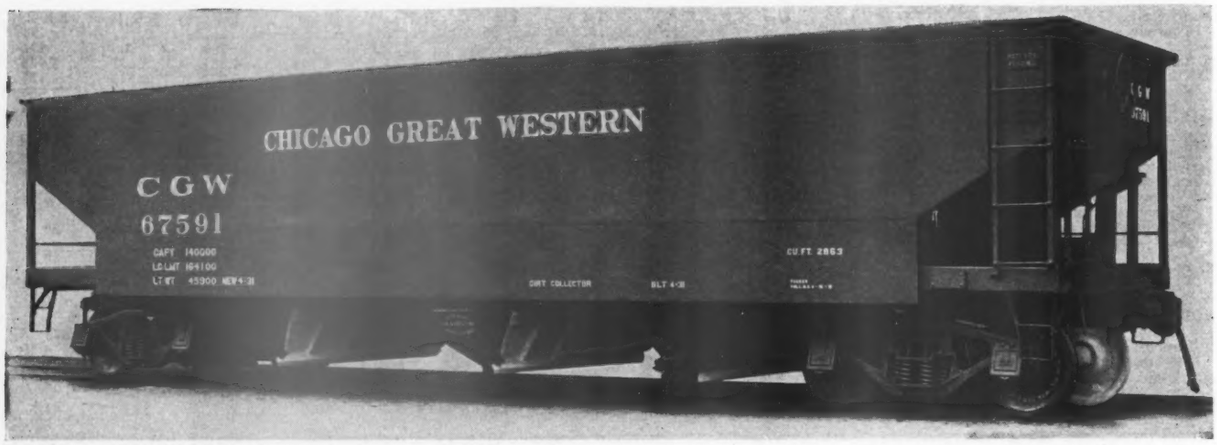
A study of the figures given in the table shows that exceptional economy was obtained, both in coal and water consumption. The coal and water consumption per drawbar horsepower per hour affords an accurate basis for this conclusion. This economy is also reflected in the high over-all thermal efficiency obtained at the drawbar.

A relatively high average speed was maintained over the division, together with an average drawbar pull of approximately 48,000 lb., indicating that the large driving wheels were a distinct advantage in maintaining a fast schedule for tonnage trains.

Owing to the fact that an apparently large drop in pressure between the boiler and steam chest is shown, some explanation in regard to the source of these figures is necessary. The averages include the steam-chest pressures observed while the locomotive was working with a restricted throttle opening for short periods. With full throttle opening and under good operating conditions, this drop was observed to be only about 10 lb. A study shows that the two units of the engine are well balanced, developing approximately the same horsepower. Although indicator cards were not taken with the object of determining maximum horsepower, they show that this would be reached at a speed well above 35 miles an hour.

As a result of these tests it is evident that a single-expansion articulated locomotive of the 2-6-6-2 type with 70-in. drivers will meet the actual load and clearance restrictions imposed, afford sufficient boiler capacity for cylinder requirements and give economical performance.

DINING CAR MURALS HONOR PIONEERS.—Mural decorations in the three new air-cooled dining cars recently constructed for the Missouri-Kansas-Texas will pay tribute to pioneers of the Southwest. Three of the panels, which will be identical in each car, represent the spirit of transportation—the covered wagon, the early train, and the pony express rider. The fourth panel depicts the Alamo. The panels also contain the state seals of Kansas, Oklahoma, Missouri, and Texas, respectively.



One of five all-welded hopper cars recently built by the Pullman Car & Manufacturing Corporation

C. G. W. All-Welded Hoppers Built by Pullman

Cars are the largest in capacity and the lightest in weight of any hoppers on 6-in. by 11-in. journals

WITH the primary object of developing a coal car to produce more revenue per pound of weight on the rails, the Chicago Great Western consented to have five units of its orders for 300 70-ton hopper cars, placed with the Pullman Car & Manufacturing Corporation in the latter part of 1930, built to a design proposed by the car builder and embodying, among other features, practically all-welded construction. These cars, recently completed and delivered to the railroad, weigh 45,900 lb. each, or roughly only as much as 50-ton cars of riveted construction. This means that 20 additional tons of coal can be carried in each car at no greater transportation expense for the movement of tare, or dead weight.

On the basis, both of reduced light weight and of increased capacity, the welded car shows marked superiority. With a light weight of 45,900 lb., it provides a cubic capacity (level full) of 2,863 cu. ft. As compared with the heaviest riveted car in the accompanying list of typical 70-ton hopper cars of recent riveted design, the welded car weighs 10,500, or 18.6 per cent. less, and at the same time provides 85 cu. ft., or 3.1 per cent, greater cubic capacity, all of which is available for carrying increased revenue load. As compared with the lightest riveted car in the list, this is a decrease of 4,300 lb., or 8.6 per cent, in light weight, a notable reduction, in view of the fact that a gain of 243 cu. ft., or 8.9 per cent, in cubic capacity is made at the same time. On the basis of $100 increased earning power per ton per year, it is anticipated that the 70-ton welded car will produce, on the average, $400 more revenue per year than one of equal nominal capacity but incorporating ordinary riveted construction.

Body Design a Distinct Innovation

The Chicago Great Western 70-ton welded hopper car is of the conventional three-hopper type, with standard four-wheel trucks and 6-in. by 11-in. journals, but the body design is a distinct innovation, no cars having previously been built with the type of construction and amount of welding used in these cars. The entire body of each car, including a one-piece welded tubular steel center sill, is assembled by welding, and the only rivets used are those for fastening safety appliances, draft-gear supports, door hooks and similar parts subject to breakage or periodic removal. Even the pipe joints are made by welding, and that process is used to attach and anchor the train line and connecting pipes to the car body.

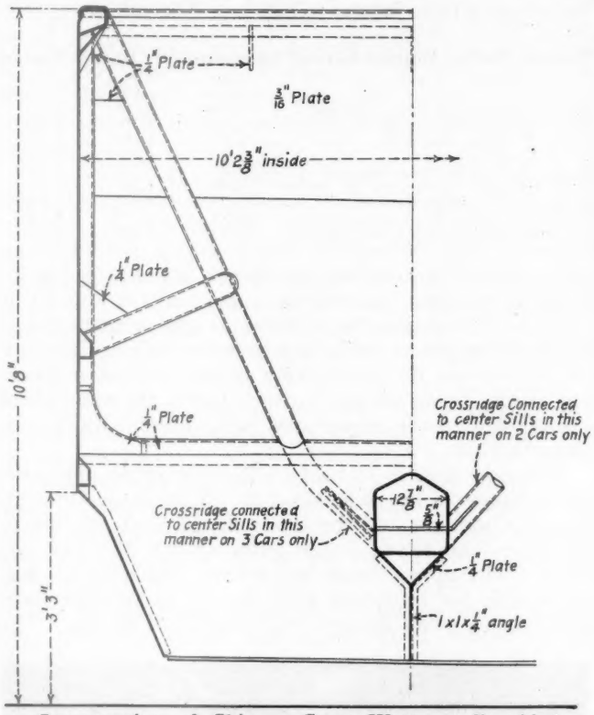
Both oxyacetylene and electric arc welding are used in the manufacture of these cars; the former on the heavier sections where strength and ductility of weld metal is the prime essential, and the latter on the light sheets where the lower heat of the arc reduces the probability of warpage.

Welding Operations Checked and Cars Tested

There are approximately 1,500 lin. ft. of welding in the car. Of the 200 lb. of welding rod required, 56 per cent is deposited by the oxyacetylene process and 44 per cent by the electric arc. The former method is used for the following parts: Center sill and all attaching parts; body bolster and all attaching parts, including side and floor sheets; all-pipe cross ridge; lower end construction; floor sheets, except where joined to the side and end construction; all pipe joints and pipe anchorage. The following parts are welded with the electric process: All side-sheet construction; all upper end construction; all dump doors. The Oxweld Railroad Service Company co-operated with the Pullman Car & Manufacturing Corporation in refining design details to meet the welding requirements and in the

supervision of the performance of the actual welding operations.

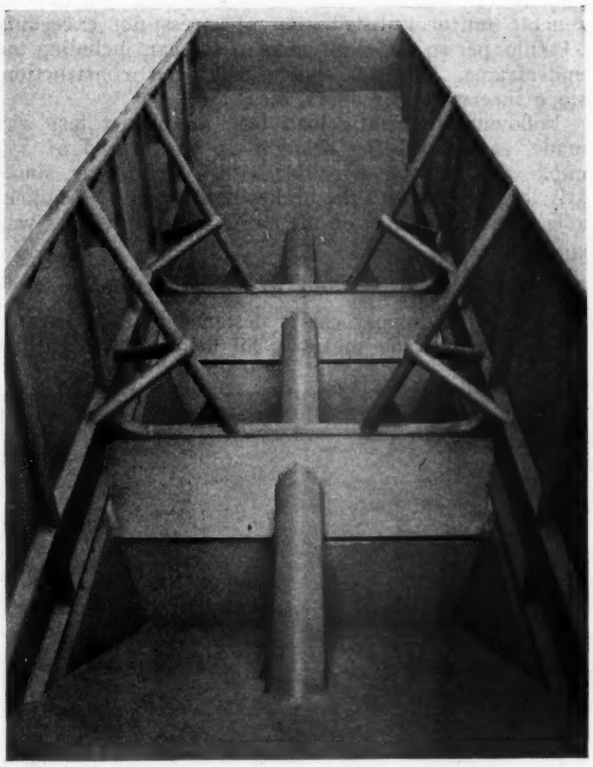
Before beginning welding operations on the new cars, extensive tests, covering a period of several weeks, were made to determine the relative efficiencies and costs of various types of welded construction required in the fabrication and assembly of the car parts. Experienced operators were used for both the oxyacetylene and the electric welding operations, these operators being required to submit test specimen welds at intervals as a check on the quality of their work. In addition, all welds were hammer tested during the course of construction, with two objectives, namely, to distribute local stresses and to permit the immediate



Cross-section of Chicago Great Western all-welded 70-ton hopper car

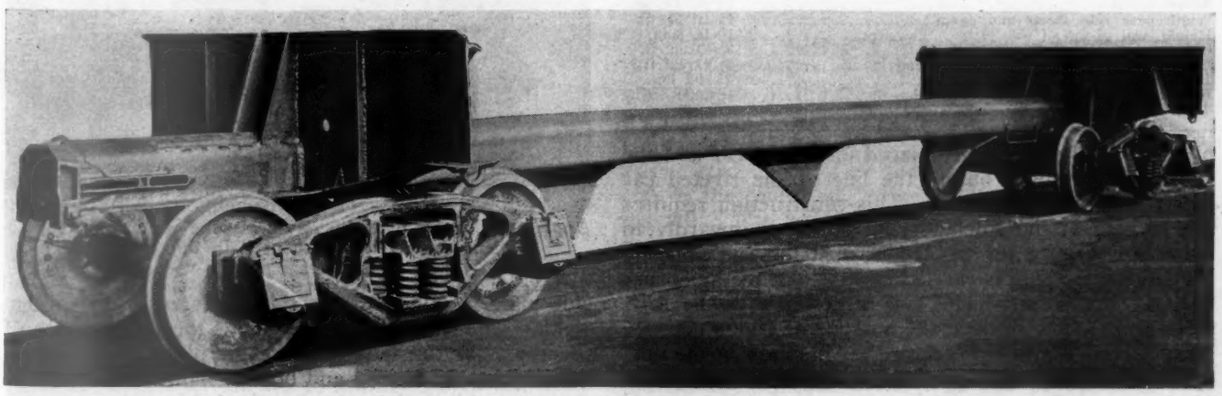
correction and reinforcement of any welds which gave indications of weakness.

Upon the completion of each car, it was painted with a cement wash, which was permitted to dry, and the car was then loaded with sand until its total weight on the rails was 210,000 lb. This load filled the car only to within 10 in. of the top, consequently being concentrated over a smaller area than would be the case with coal loading, and introducing stresses in excess of any likely to be encountered under normal operation. A careful examination of joints gave no indication of the cement flaking off due to working of the joints or movement of the plates.



The interior construction of the all-welded hopper car—Patents are pending on a number of features embodied in the construction of these cars

In addition to this practical test for stresses beyond the elastic limit, the loaded car was thoroughly tested with extensometers to measure the elongations and to determine the relative stresses within the elastic limit encountered in various car parts. The use of the extensometers showed uneven stresses in certain parts of the car on the first loading, as, for example, around the bolster, which was reinforced and another test made. Certain plates also showed excessive stress on the initial loading, which was equalized on subsequent applications. As finally tested, each car showed a rea-



All-welded tubular center sill and bolster construction used in new Chicago Great Western hopper cars

sonably uniform distribution of stress not exceeding 9,000 lb. per sq. in. in all parts of the car, including the underframe, bolsters, side sheets, end construction, slope sheets, hopper doors, etc.

Following the static load test, an impact test was made, each car being brought up to a speed of 5½ m.p.h. and allowed to collide with a second car, similarly loaded, but with the brakes lightly set. No noticeable permanent effect on the structure of either car was apparent.

General Method of Construction

The welded hopper car is designed to take advantage of the welding to tie in all members so that all

Hopper door fabricated by electric arc welding

parts of the underframe and superstructure act as a unit in resisting draft, buffing and load stresses. Pressed shapes, with large radii at the corners, are used, these shapes lending themselves to the welded construction much better than the usual structural shapes, and having the additional advantage of being light in weight. When welded to the sheets, they form box sections of greater strength per unit of weight than the usual structural shapes used in riveted cars. Flanges are largely omitted, not being required for the application

General Dimensions of Chicago Great Western All-Welded 70-Ton Hopper Car

Length over strikers	42 ft. 0 in.
Length over end sills	41 ft. ⅛ in.
Height, rail to body center plate	2 ft. 2¾ in.
Side bearing centers	4 ft. 2 in.
Distance between truck centers	32 ft. 0 in.
Truck wheel base	5 ft. 8 in.
Length inside	41 ft. 0 in.
Width inside	10 ft. 2⅛ in.
Width over side sheets and overall	10 ft. 2¾ in.
Height, rail to top of side plate	10 ft. 8 in.
Cubic capacity level full	2,863 cu. ft.
Cubic capacity with 10-in. average heap	3,197 cu. ft.
Light weight of car—lb.	45,900 lb.
Revenue load with 10-in. average heap—lb.	164,000
Total weight on rail—lb.	210,000

of rivets. The stakes are placed inside the car and the side sheets brought out to the line of the riveted car to give maximum capacity. This construction requires the corners at the sideladder to be offset inwardly to provide clearance for the ladder. At the end opposite the ladder, the side is carried straight out to the corner without any offset. The car is designed to be self-clearing in every respect, the absence of rivets contributing effectively to this feature. All joints in the coal space are made with continuous welds so that there are no openings to permit the entrance of moisture and dirt and promote corrosion. In addition, the slope sheets are given a pitch of 1¼ in. from the sides toward the center, in order to drain water away from the corners where corrosion takes place. In addition, this construction tends to keep the center of the load moist and assist in unloading.

The body bolster is built up with a bottom cover plate and a web plate with proper flanges at the top for supporting the floor sheets. The sides are made of two sheets, joined with a continuous butt weld for their entire length. This provides a heavy sheet where the corrosion and hammering is most severe and saves considerable weight where the greater thickness is not required.

The side still is formed of a plate in a channel shape in one piece from bolster to bolster. The side-sheet stif-

Typical 70-Ton Hopper Cars of Comparatively Recent Design

Road	Light Weight	Cu. Cap. Level Full	Cu. Cap. 10-In. Heap
New York Central (three hoppers)	50,200	2,620	2,948
D. L. & W. (three hoppers)	50,800	2,755	3,062
N. & W. (four hoppers)	51,500	2,439	2,729
C. G. W. (three hoppers)	52,675	2,778	3,100
C. M. St. P. & P. (four hoppers)	52,800	2,778	3,100
B. & O. (four hoppers, A.R.A. design)	52,900	2,736	....
C. & N. W. (four hoppers)	54,900	2,590	2,900
I. C.	56,400	2,778	3,100
C. G. W. (All-welded, three hoppers)	45,900	2,863	3,197

fener is of the same section as the side sill, being located at the joint between the upper and the lower side sheets. This locates the stiffener at approximately one-third the height of the side where the bulging is greatest and where the hammering occurs to loosen freezing loads. These stiffeners run between the stakes and are welded to the stakes and side sheets with a continuous weld.

The side plate is formed of ¼-in. plate in much the same shape as the side sill, but, in this case, the top flange is straight and the lower flange is sloped downwardly. The lower flange butts against the top side sheet. The upper flange has a small flange at 45 deg. to provide for lining up with the top of the side sheet which has a small flange bent inwardly at 45 deg. The

Applying a center plate by oxy-acetylene welding to supplement the riveting also used in this instance

side plate is joined to the side sheet with intermittent welds. The side plate is continuous the entire length of the car. At the ladder pocket, a plate is introduced which joins to the top and bottom flanges and the side sheet, providing clearance for the ladder.

The side-plate gussets, of ¼-in. plates, are located be-

tween the stakes, approximately 3 ft. apart, to provide further stiffening and connections between the side plate and side sheet.

Side Stakes Made in Channel Shape

The side stakes are formed in channel shape. There are seven stakes per side, all but the bolster stakes being rectangular in section. The bolster stakes have the flange towards the end of the car at an angle to provide for clearing the lading. The bolster stakes extend from the slope sheet to the side plate. A ¼-in. plate, 14 in. wide, extends from approximately 12 in. above the slope sheet to the side sill and is flanged under the bolster. The stakes are joined to the side sheets with continuous fillet welds.

The cross ridge extends across the car in one piece, with a gusset pressing of approximately the same cross section at the sides. Connection plates support the cross ridge at the center sill. The upper end of the gusset piece is formed in rectangular shape to join with the side stake.

The cross-ridge gusset is formed of 4-in. standard pipe, extending from the side plate through the cross ridge to the center sill. Longitudinal bracing is provided by two pieces of 4-in. pipe at 60 deg., extending from the side-sheet stiffener to the cross ridge gusset. Gussets, of ¼-in. plate, are placed between the cross ridge and the pipe, and the side stake and pipe at the side plate. Horizontal gusset plates are placed between the pipe and the center sill.

The end sheet is a $\frac{3}{16}$-in. plate with a small flange at the bottom to take the slope sheet and the same flange as the side sheets at top for connection to the end plate. This flange extends outwardly on the end sheets, however, as the end plate is placed outside the car. The end plate is the same section as the side plate, the bottom flange being offset at the end ladder to provide proper clearance.

The corner posts are structural angles joined to the end and side sheets with intermittent welds on the outside and continuous welding inside the car. The end posts are structural channels joined to the end sheet with continuous welding.

The end sill is a structural angle welded to the center sill and to the end and corner posts. The sub side sill is a channel pressing with the flanges inward. There are no offsets in this member, which extends in a straight line from the end sill to the bolster web, to which it is welded. Diagonal braces of ¼-in. plate, pressed in channel shape with the flanges down, extend from the corner to the center sill at the bolster, being welded in place.

Hopper Sides, Door and Hinge Construction

The outside hopper sides have a small flange to take the floor sheets and the edge at the door is pressed in a Z-shape, as is usual in hopper cars. These sheets are welded to the extension of the car sides, which are carried down 1 in. below the side sill for this purpose. One-quarter-inch gusset plates are placed between the side sill and the hopper sides, approximately 2 ft. apart.

These cars have a single inside hopper sheet on the center line of the car, the completed sheet is Y-shape, one plate extending from the edge of the center sill to the bottom, forming one side and the leg of the Y. A relatively short plate extends from the other side of center sill to the first sheet, forming the V-shaped opening in the upper part of the Y, through which the brake rod passes.

Three hopper doors are provided per car, in place of six, as in the usual practice. Each door is made of flat ¼-in. plate, with a channel-shaped stiffener of ¼-in. and $\frac{3}{16}$-in. plate, welded to it with intermittent welds. The doors are arranged for the application of hooks for holding them in the closed position.

New Type Hopper-Door Hinge

The hopper-door hinge is a new type, being continuous from the side to the center sill on each side of the car. The hinge butt is a channel-shaped pressing of ⅜-in. plate. The top flange is welded to the floor sheet, forming a stiffener for the edge of the sheet. The lower flange is formed to fit a 1¼-in. pipe and the door sheet is flanged to fit over this pipe. The door is applied by placing it in position and inserting the 1¼-in. pipe from the side of the car, after which a plate is welded to the outside which holds the pipe in place. The pipe prevents the door's becoming unhinged and forms the pin around which the door works. Continuous support is given the door, and this weight is distributed evenly along the edge of the floor sheet.

The floor sheets are of ¼-in. plate without flanges. They have a transverse slope, being 1¼ in. lower at the center line of the car than at the sides. The long slope sheets are in two pieces, welded on the longitudinal center line of the car. The cross-ridge sheets are in one piece from side to side, notched to fit around the center sill. All floor sheets are welded to the center sill and sides. A channel-shaped stiffener of ¼-in. pressed plate is provided under the lower edge of the slope sheets at the door opening.

The brake fulcrum brackets and lever guides are welded to the center sill. The brake-cylinder brackets are flanged plates welded to the bolster, diagonal brace and center sill. The auxiliary-reservoir brackets are welded to the bolster and to center sill and diagonal brace. The brake cylinder and reservoir are bolted to the brackets to provide for ready removal. The piping for the brake system is welded without couplings or fittings except where fittings are necessary for the removal of parts, such as triple valves, pressure retainer, etc.

The cars are arranged for standard draft gear with horizontal yoke. The back stop and bolster center filler is a steel casting with lugs on the side which engage slots in the sides of the center sill. The opening between the lugs and the center sill web are closed by welding, which makes the casting an integral part of the center sill. On the bottom of the casting are lugs which extend through the bottom bolster plate and the body center plate. These holes around the lugs are filled by welding, which makes the center plate practically a unit with the center filler casting and center sill.

The cheek plates are steel castings, which, in addition to the flanges for the draft keys, have lugs which engage slots in the center sill. These lugs, as well as the draft-key supporting flanges, are welded to the center sill, forming a unit with it.

The striker is a steel casting arranged to fit over the end of the center sill, with surfaces to butt the end of the sill. The welding makes this casting an integral part of the sill.

FIFTY YEARS AGO.—The important subject of car couplers which will protect switchmen will be considered by the coming convention of the master car builders, although there is a natural disinclination on the part of the association to officially endorse any particular device from fear of benefiting some inventor.—Railway Age, May 26, 1881.

Shopping Union Pacific Locomotives

Increased reliability and serviceability and reduced unit maintenance cost are objectives of system policy

SINCE 1923, the Union Pacific Railroad, and subsequently all four units of the Union Pacific System, had been following a policy of periodic monthly inspection and conditioning of locomotives, generally conceded to be one of the most important single factors in the successful extension of locomotive runs with their attendant operating economies. Between 1924 and 1931 locomotive utilization, measured in miles per active locomotive per month, increased 10 to 15 per cent; mileage between shoppings for general repairs, 80 per cent or more, and locomotive-miles per failure, over 100 per cent, a striking accomplishment in view of the greatly increased severity of the service due to higher train speeds, heavier trains and increased tractive force, as shown in one of the tables. The remarkable decrease (50 per cent in four years) in the number of locomotives found with federal defects also reflects a great improvement in motive-power conditions.

Form 2325

NAME OF WORKMEN | RATE | WORK ORDER | CHARGE

DATE _____ 192__

LOCATION | Job No.

DESCRIPTION OF MATERIAL OR WORK TO BE DONE

COMMENCED		COMPLETED		MAN HOURS		SCHEDULE TIME	
DATE	TIME	DATE	TIME	HOURS	MINS.	HOURS	MINS.

FOREMAN

Combination work order and individual job check, filled out by foreman

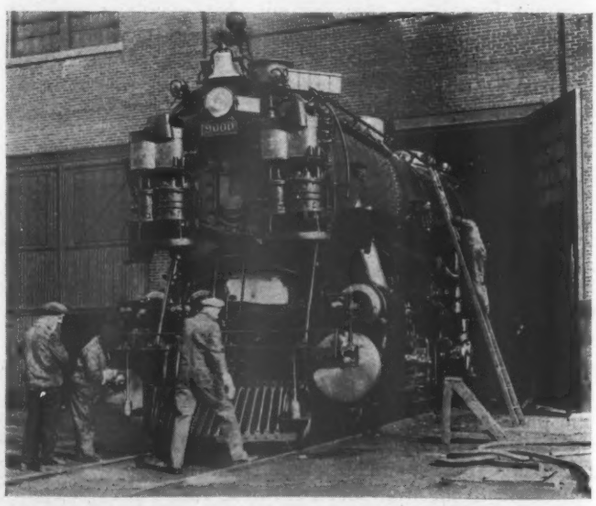
In conjunction with the careful monthly conditioning of locomotives at engine terminals and the greatly increased mileage between heavy repairs, the Union Pacific instituted in 1927 a program of concentrated attention on relatively fewer motive-power units undergoing repairs at one time in each shop, with the result that the average shopping time on heavy power was cut from 43 to 19.8 working days per locomotive given Class 2 repairs; 30 to 14.6 days for Class 3 repairs, and 20 to 8.6 days for Class 5 repairs.

A production time study system was also installed in the shops, providing a more accurate knowledge of conditions and an incentive for improvement not previously available. Effective labor-saving devices and methods developed at each system shop were applied to others, an improved standard-practice folio being developed. Friendly competition, as well as an interchange of ideas, was stimulated between the respective shop points, shop efficiency being proportionately increased. Without any sacrifice of quality and in spite of a large amount of betterment work, such as the application of locomotive bed castings, feedwater heaters, etc., the man-hours per Class 3 repairs on heavy Pacific type locomotives were cut from 6,000 in 1924 to 3,712 in 1931. Class 2 repairs dropped from 6,500 to 4,300 man-hours in the same period. Class 3 repairs to a 2-10-2 type locomotive required 5,400 man-hours in 1924 and only 4,500 man-hours in 1931.

Concentration, specialization, and modernization are three words which perhaps best describe the present locomotive shopping policy of the Union Pacific. Heavy maintenance operations on the system are concentrated essentially at five major shops; namely, Omaha, Neb., Cheyenne, Wyo., Pocatello, Idaho, Portland, Ore., and Los Angeles, Cal. In addition, Class 4 and 5 repairs are handled quite extensively at nine intermediate repair shops, which compares with nearly 25 intermediate points formerly making all classes of repairs.

Shop Production Time Study Produces Results

A notable improvement in the standards of shop machinery and labor-saving equipment has been accomplished on the Union Pacific in recent years. Typical new equipment installed includes machine tools, welding equipment, heating furnaces, electric drop pits, power-operated crane trucks, pneumatic tools, etc., which are such a vital factor in efficient shop production. Grinding machines, in particular, have proven their value in providing accuracy, smooth finish and minimum stock removal. All new crank pins, for example, are finished by grinding and crank pins, not removed from the wheel centers, are ground by means of a portable machine. With floating-type bushings, accurately finished, the



Applying the finishing touches to U. P. Locomotive 9000 at Omaha Shops

service life of these bearings has been practically doubled, effecting large savings in labor and material costs as well as locomotive out-of-service time.

The results of the system of shop production time study, started in the Union Pacific Railroad locomotive department in 1927 and subsequently extended to all major and intermediate repair points on the system, have already been outlined. The principal feature of the system is its simplicity, only four forms being required and the general direction being provided by one production supervisor and three assistants for the system.

The purpose of the production system is to increase unit shop production without the overhead expense involved in handling work under a bonus system. Shop supervisors know at a glance how long detailed repair operations are taking compared to what can be done. Shop men are specialized to as great an extent as practical and provided with the tools, working conditions and facilities needed for most efficient operation. Moreover, a knowledge of what is being accomplished by other men in the same shops or by other shops on the system creates a feeling of friendly rivalry in the development of improved methods and labor-saving devices. Emphasis is placed on a high standard of workmanship which is the first consideration.

When this system was first inaugurated it was found that some supervisors had little accurate knowledge of the man-hours required for various operations performed under their direction and in their departments and in many cases two men were assigned to do one man's work. Supervisors are now careful to study and assign jobs to men who are best adapted to the respective classes of work and they also see that on jobs requiring more than one man, only the number of men required to perform the work with safety and efficiency are used.

The locomotive maintenance work is divided into seven departments, including the boiler, machine, erecting, blacksmith, pipe and jacket, electric, and miscellaneous departments, each of which has an over-all assignment of schedule man-hours for ten individual classes of locomotives. In addition, the detailed maintenance operations are divided into groups numbered from 10 to 99 and including approximately 7,000 jobs for each of the ten classes of power.

The four forms mentioned include a work order and individual job check filled out by the foreman, one form on which information from the individual job check forms is consolidated, another form which gives the comparative performance of individual units of the

(Concluded on page 411)

Form 7005

UNION PACIFIC SYSTEM

SCHEDULE JOB SHEET

C. S. 11-29-30,000 Temporary Form 43 (Revised)

DESCRIPTION_____ Group No._____

Job No._____

U. P. R. R.					O. S. L. R. R.					O. W. R. R. & N.					L. A. & S. L. R. R.						SCHEDULE TIME	
LOCATION	No. of Jobs	TIME Total Hrs.	TIME Total Mins.	TIME Aver. Hrs.	TIME Aver. Mins.	LOCATION	No. of Jobs	TIME Total Hrs.	TIME Total Mins.	TIME Aver. Hrs.	TIME Aver. Mins.	LOCATION	No. of Jobs	TIME Total Hrs.	TIME Total Mins.	TIME Aver. Hrs.	TIME Aver. Mins.	LOCATION	No. of Jobs	TIME Total Hrs.	TIME Total Mins.	TIME Aver. Hrs.	TIME Aver. Mins.	Hrs.	Mins.

Master form showing number of jobs checked and comparative times for individual shops on the system

Typical Machinery and Shop Equipment Installed on the Union Pacific During the Past Three Years

Arc welders
Horizontal boring machines
Portable boring bars
Radial drills
Flue cutters
Flue welders
Heating furnaces
Swing grinders
Crank pin grinders
Steam hammers
Axle burnishing lathes
Car axle lathes
Journal turning and quartering lathe
Engine lathes
Turret lathes
Pipe threading and bending machines
Hydraulic shapers
Upsetting and forging machines
Tilted sandblast machines
Veneer press
Electric drop pits
Pneumatic wrenches and other small tools
Crane-type trucks
Lift trucks
Skids and material-handling boxes

Comparison of Present and Former Monthly Locomotive Mileage and Mileage Between General Repairs

Type	Locomotive-miles per month 1931	Locomotive-miles per month Prior to 1929	Miles between general repairs 1931	Miles between general repairs Prior to 1929
Heavy Pacific	9,210	8,300	211,000	165,000
Mountain	7,700	7,200	226,000	180,000
Consolidation	2,550	2,100	76,000	60,000
Mikado	4,450	4,000	89,000	60,000
Mallet	3,870	3,300	93,000	40,000
2-10-2	5,800	5,300	98,000	75,000
4-12-2	6,500	6,200	152,000	125,000

Form 7130

C. S. 1-30-31,000

UNION PACIFIC SYSTEM

_____ **COMPANY**

TEST JOB CHECKS _____ **DEPT. DATE** _____ **193**__

GROUP NO.	JOB NO.	LOCATION	OPERATION	NO. OF JOBS	CLASS OF ENG. OR CAR	TOTAL TIME HRS.	TOTAL TIME MINS.	AVERAGE TIME HRS.	AVERAGE TIME MINS.	SCHEDULE TIME HRS.	SCHEDULE TIME MINS.	CHANGE RECOMMENDED HRS.	CHANGE RECOMMENDED MINS.	REMARKS

Consolidation form for data drawn from individual job check slips

Fluid-Film Lubrication as Applied to Journal Bearings

By F. O. Willhofft*

Abstract of a paper presented at the Fifth Oil-Power Conference which was held at Penn State under the joint auspices of the college and the Lubrication Engineering Committee of the Petroleum Division, A.S.M.E.

THIS paper is restricted to partial bearings, of the A. R. A. type, which are subjected to a load acting on the top of the bearing. The loads are comparatively high, nominal loads varying between 355 and 385 lb. per. sq. in. of projected area, and actual loads reaching values as high as 485 lb. per sq. in. The maximum rubbing velocity may be as much as 1,200 ft. per min. or more.

Until recent times the knowledge possessed by the average engineer, both operating and designing, concerning the theory of lubrication was somewhat hazy. Text books stated that there were three kinds of friction, solid friction, semi-fluid friction and fluid friction, but information about the basic laws was decidedly fragmentary and inconclusive. Usually a number of tests were cited, giving numerical values for the coefficient of friction under certain conditions, but no information seemed to be available which would assist an engineer in designing a bearing so as to give the best results with any given combination of variables. Any one who seriously attempted to acquaint himself with the theory of lubrication was immediately confronted with mathematical formulas which staggered even those who had not altogether forgotten the differential calculus of their school days. Worse still, these formulas seemed to have no direct bearing upon actual practice any more than the results obtained on the so-called friction testing machines found in college laboratories.

Fortunately, we have quite a different state of affairs today; A mere glance at the reports of the A. S. M. E. Special Research Committee on Lubrication will disclose how much has been done during the last few years in the analytical and experimental investigation of lubrication problems. All engineers interested in lubrication owe a great debt of gratitude to this committee, not only for the exhaustive and systematic compilation of all the information available on the subject but also for the valuable work contributed by the individual members of the committee and the stimulus they have given to the industries interested in lubrication problems.

Vast Amount of Work Remains To Be Done

A vast amount of work still remains to be done. Of greatest immediate importance to industry are the experimental investigations now under way or being planned for the purpose of determining actual oil-film pressures on bearings of commercial size and design, and with methods of lubrication and working conditions duplicating those prevailing in practice. The earlier tests were mostly made on small bearings and under arbitrary laboratory conditions, thus being of little immediate usefulness to the student trying to collect practical data. The fact that means have been found to finance the necessarily costly experiments on bearings of commercial sizes constitutes a welcome acknowledgement of the importance of the problems of lubrication and of the need of additional information.

A pressure gage speaks a language which every engineer understands, even though he is unable to follow or can only partially digest the writings of Reynolds, Petroff, Harrison, Sommerfeld, and other pioneers in the field who have laid the foundation for or developed the theory of film lubrication. The experimental investigations of actual bearing conditions, now under way at various places here and in Europe, and of which the work done by Professor Bradford[1] at State College, Pa., is a splendid example, will furnish us with practical cofficients for the theoretical equations or may even necessitate the formulation "of a new set of equations more in accordance with conditions existing in an actual bearing."

Such tests confirm to the practicing engineer the correctness of the hydrodynamic theory of fluid lubrication. They prove that, given the proper conditions, a bearing will actually "ride on oil," and that the maximum pressure of the oil film is several times the average unit load. They show how the film pressure rises and falls between entry and leaving and how it varies from one extremity of the journal to the other. They even give a measurement of the film thickness at the various points, and they demonstrate the effects of deflections of the journal on pressure distribution. The tests show that fluid film lubrication will reduce the coefficient of friction to values varying between 0.001 and 0.003, depending upon the characteristics of the lubricant.

Is Fluid-Film Lubrication Realized in Present Practice?

The question then arises whether fluid-film lubrication may be realized in ordinary commercial bearings, such as railroad-journal boxes, and what the requirements are. The latter may be summarized as follows:

1—The supply of oil at any speed must be sufficient to maintain an unbroken film of the necessary thickness over the whole load-carrying surface. In view of the extremely small thickness of the film the amount required for this purpose is naturally very slight.[3]

2—The supply of oil at any time must be sufficient to make up for the oil lost by leakage at the two ends of the bearing due to the flow from the maximum pressure zone to the two ends where atmospheric pressure exists. In order to preclude the breaking down of the film at any point the supply must be largely in excess of the requirements. According to Karelitz[2] who has determined the end leakage

* Mr. Willhofft is general manager of the Isothermos Corporation of America, New York.

[1] Oil Film Pressures in a Complete Bearing, by L. J. Bradford and L. J. Grunder, Pennsylvania State College Bulletin, Sept. 8, 1930.

[2] R. O. Boswall, The Theory of Film Lubrication, Longamans, Green & Co., and G. B. Karelitz, Performance of Oil-Ring Bearings. Trans. A.S.M.E. 1930.

[3] Ibid.

in ring-oiled bearings, the oil supply should be, say, twice the oil loss through end leakage.

3—Oil should always be available at the leading edge of the bearing, and over the whole length of it, in sufficient quantity to permit the formation and maintenance of a solid oil wedge. The edges of the bearing are preferably rounded or chamfered to facilitate the forming of the oil wedge when starting.

4—The inside of the bearing in the pressure zone should not have any grooves or holes communicating with atmospheric or low pressure zones since such grooves or holes would interfere with the building up of the pressure in a continuous oil flow.

5—The bearing arc should be long enough to permit the required maximum pressure to be developed in the oil film but not so long as to result in the formation of negative pressure on the down side which would cause air to enter and interrupt the film. According to Boswall it seems that the arc of contact should be limited to about 90 or 100 deg. and "there seems to be no reason why, in certain cases, an arc of contact as low as 60 deg. should not be successfully employed."

6—The rubbing velocity, i.e., the peripheral speed of the journal, must be sufficient to permit the formation of the complete film of adequate thickness, but authorities greatly differ as to the minimum speed at which greasy lubrication changes to fluid lubrication.

7—The load applied must not exceed the load carrying capacity of the oil used.

Limitations of Waste-Packed Journal Boxes

Waste-packed journal boxes cannot meet the second and third conditions because, no matter what the material of the packing, no matter what methods are used to keep the packing saturated with oil and in contact with the journal, the amount of oil deposited on the journal by the packing is less than the minimum required for fluid-film lubrication. Furthermore, normal flow of oil through the packing cannot take place unless the temperature is sufficiently high. The only source of heat available is friction, or in other words enough heat has to be created by friction to make the oil flow which means a bearing temperature well above 100 deg. F.

This process, particularly in cold weather, requires quite a long time. During this period the supply of oil is still more deficient, lubrication depending upon the oil held in the clearance spaces by capillary attraction while the journal is at rest. This supply at best is but scant, sufficient only to form a greasy film adhering to the metal surfaces and apt to break down altogether. Most of the wear of waste-packed bearings undoubtedly takes place during these periods of warming up and, what is far more serious from the economic point of view, furnishes an additional striking argument in favor of positive-flood lubrication. The tonnage rating has to be materially reduced during the cold season as long as waste-packed journal boxes are used.

Many Devices Invented to Overcome Limitations

Not so much the inherent inability of the waste-packed bearing to supply fluid-film lubrication about which little was known, but the fact that its successful operation depends on human skill and watchfulness, and certain failings, which are well known and need not be discussed here, have naturally inspired numerous inventors to develop more positive devices for railway journal lubrication. In the patent literature we find mechanically lubricated journal boxes as early as the middle of the last century. That in spite of its manifest shortcomings and of the activity of the inventors, the waste-packed journal box still is the universal standard in this country, would seem to indicate that the more positive and more efficient methods of lubrication successfully employed in other lines of engineering are not adapted to the severe requirements of railroad practice. The reason is that oil rings, pumps, rollers, chains, gears, disks with wipers and other devices subject to wear introduce a new element of risk and, at best, require frequent inspections and replacements to prevent failure; in other words, they still depend for success on the human element just like the waste packing. Furthermore, the best of mechanical means for supplying the bearing with oil are useless unless at the same time the oil is retained in the journal box so that the latter may be operated over long periods of time without requiring any attention whatsoever. And another requirement: The oil must be retained irrespective of and without dependence upon the dustguard, so that failure of the dustguard will not endanger the oil supply, also because the problem of making a dustguard dust and water tight and, at the same time, durable is rendered more difficult and uncertain when oil is permitted to mix with dust.

[The remaining portion of Mr. Willhofft's paper was devoted to a description of the Isothermos method of lubricating car journals. A description of the device appeared in the Railway Age Daily Edition, June 20, 1928, page 1420D39—EDITOR.]

Shopping Union Pacific Locomotives

(Continued from page 409)

Union Pacific System, and a mimeographed statement issued periodically showing the best average time for individual operations at all shop points. In this way, an unusually good performance on any particular job is quickly called to the attention of all system shops and, if due to improved equipment or methods, these can be adapted as generally as practicable.

Experience on the Union Pacific has shown that this system makes work lighter and easier both for the workmen and the supervisors, and desired improvement is effected more often by the use of proper methods and tools, coupled with the elimination of lost time, than by speeding up men and machines. In other words, the entire system is designed to offer an inducement for supervisors and men to use their heads and produce as good an output as possible with a reasonable expenditure of physical effort.

* * *

One of 60 all-welded steel cars recently placed in service on the Netherlands Railways. The car is 50-ft. long and has a capacity of 3,500 cu. ft. By making the car of all-welded construction the designers estimate a saving of 2.2 tons in weight

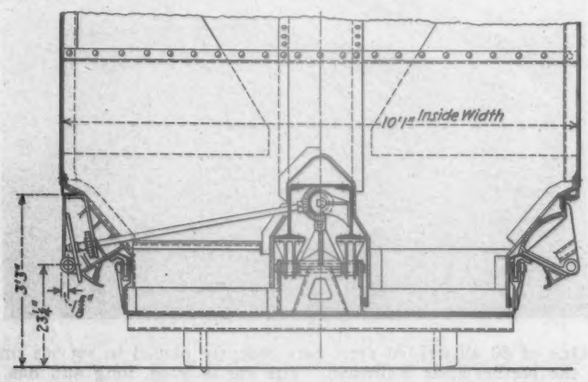
Revenue Hopper Car Can Be Used for Ballast Distribution

A DESIGN of bottom doors and side gates for standard hopper cars which can be opened and closed under load has been brought out and applied to an existing car by the Magor Car Corporation, New York. This door arrangement which can be applied to existing cars or built into new equipment makes these cars available for track ballasting without reducing their adaptability for revenue service. Furthermore, the ability to control completely the opening and closing of the bottom doors and the side gates provides for complete control of the flow of ballast and for its selecting distribution between the ties and beyond either or both ends of the ties. The ability to control the flow of material from the car is also particularly useful in revenue service for unloading coal and certain building materials at the yards of local dealers where it is desirable to regulate the flow to the capacity of mechanical conveying or truck loading equipment without the necessity of completely blocking the track until the car has been completely unloaded.

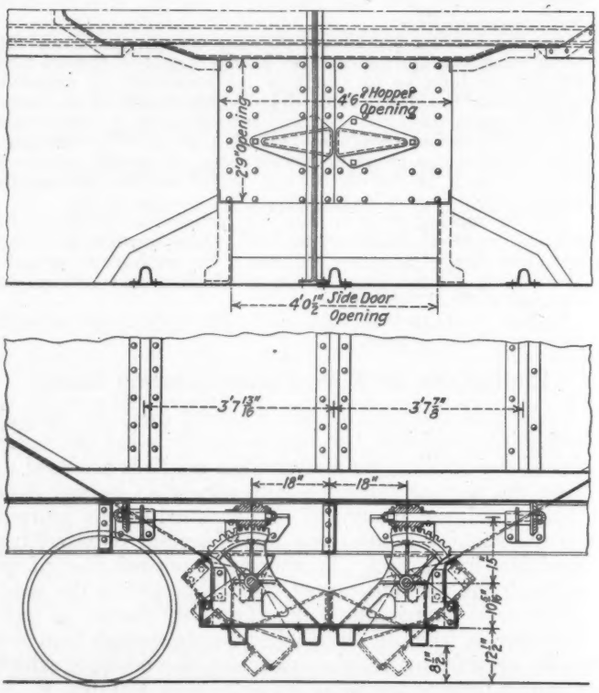
These doors and side gates have no appreciable effect on the volumetric capacity or weight of the cars in the construction of which they are embodied; neither do they restrict the bulk unloading of materials. The cars embodying these features may be diverted from revenue service to maintenance of way service, or vice versa, without the necessity of making any alterations or adjustments.

Essentially, the new design converts the lower part of each of the V-shaped hoppers of a standard car, with its hinged door opening, into a rectangular-shaped hopper with two drop doors, and adds down-cut discharge gates on each side of the car, directly in line with the bottom openings. The rectangular-shaped hoppers of the new design, like the V-shaped hoppers of the standard car, are divided into two units by the center-sill construction of the car.

Operation and control of the new bottom doors are effected mechanically through shafting and gears, from the side of the car, and in such manner that the flow of material can be increased or decreased at will during dumping, and actually shut off entirely, if desired. The side gates provide wide and deep openings, the depth of



Cross-section through the hopper showing the down-cut side gate



Sectional elevation and half plan showing the construction of the hopper doors and operating mechanism

The bottom doors are fully open—The side gate is closed

which can be altered at will by the operator during the flow of material, even to the extent of stopping the discharge entirely. Through these features, ballast can be unloaded on to the track in the exact quantity desired at various points, on one or both shoulders alone as needed, throughout the length of the ties alone, if desired, or over the entire width of the track.

The doors under each main hopper are of heavy steel-plate construction, reinforced on the bottom, and are provided with vertical flanges on the sides and rear to give them a tight seal when closed and to confine the flow of the material laterally when opened. Each of the two doors is mounted on and is keyed to a trunnion, transverse to the car, which brings the doors together in a horizontal plane when closed, and in-

D. L. & W. 70-ton hopper car fitted with Magor bottom doors and side gates suitable for revenue service or ballast distribution

clined downward, away from each other, when they are opened.

Operation of the doors in each case is by means of a hand wheel at the side of the car, which is connected mechanically to the door through shafting, a pair of beveled gears, and, immediately at the door trunnion, through a worm and gear segment. Through this mechanical arrangement, in which all parts are accessible and protected beneath the car, the doors can be opened and closed easily. On the other hand, the loading on the doors and the gear ratio provided in the operating mechanisms are such that the doors hold themselves rigidly when closed, or at any degree of opening, regardless of the load condition. To insure positive locking of the doors during the road haul of material, a ratchet and pawl with a cam pawl keeper is provided directly at each hand wheel. Ease in the operation of shutting off or reducing the flow of material by closing the hopper openings has been affected through pivoting the doors near their transverse center line, wherein the weight of the material tending to force them open is counterbalanced in part by the weight of the material on the opposite side of the trunnion support. Full opening or closure of all of the doors on a two-hopper car can be made in about 1½ min.

From the bottom doors, ballast is spread over a width equal to the length of the ties, but is kept from being deposited directly on the rails by means of deflectors of suitable shape, attached to the upper faces of the doors, directly over the lines of rails. The ballast is distributed quite uniformly on each side of the rail, except directly through the center of the track, where the distribution is considerably lighter owing to the obstruction caused by the center sill of the car. This is offset to some extent by the shape of the deflectors provided to keep the rails clear, which direct the ballast over a wider area between the rails than outside the rails.

The side gates provided in the new design, which are essentially for unloading ballast on to the track shoulders, consist in each case of a cylindrical cast-steel segment pivoted at each end. These gates, when in normal position, close off openings in the sides of the hoppers, directly alongside the bottom doors. The gate segment itself, which is provided with a tongue and groove on each side to prevent the leakage of fine material, is so mounted that it stays in a closed position, of its own weight, entirely within the side clearance of the car body.

The gate is opened upward and outward, rotating about its end bearings, by means of any suitable bar. The end of the bar is simply inserted in either of two cored sockets provided on the ends of the gate casting, and the bar used as a lever in opening or closing the gate under load. Through the curved face of the gate and the position of the sockets, one man on the bar can open and close the gate readily even when under full load pressure.

Through regulation of the side gates, the ballast is distributed over a width up to 24 in., from the ends of the ties out and thereby replenishes the ballast on the shoulders only.

With the door and gate controls close together directly along the side of the car, one man can distribute the ballast over the width of the track proper and on one shoulder at the same time. Where both shoulders are being ballasted simultaneously, an additional man is required to operate the gate on the opposite side of the car.

* * *

Three-wheel truck designed to save labor in handling bolt material at the C. & N. W. (Chicago) blacksmith shop. The material does not touch the floor from the time it arrives at the shear as bar stock until it passes the forging machine, and bolt threader and is delivered to the storeroom. Note convenient metal order pocket on the side of the truck.

EDITORIALS

A Test And A Challenge

Seneca, the Roman philosopher and tutor to Nero, made the statement in De Providentia that, "Fire is the test of gold; adversity of strong men."

The Omaha Bee-News published an editorial a few months ago under the title, "Business Leaders Emerge in Red Ink Years." It contained this significant statement: "Adaptability to radical changes has become a prime attribute for successful management in this era of mercurial shifts in conditions."

President R. H. Aishton, of the American Railway Association, in addressing the meeting of the Mechanical Division at Chicago in June, appealed to the members to be receptive to new ideas and willing to violate all precedents, if necessary, in helping fit the railroads to meet new conditions successfully. He challenged railroad men to keep their eyes open to new developments which are going on everywhere about them. Past experience, he said, has shown that practically every vital improvement in railroad practice and operation has at first been looked upon with skepticism and distrust.

President Aishton might also have truthfully stated that there is a wide gap between the best and poorest practices on the different railways, and that if all of them were using the best methods, or practices, or equipment adopted by some of them, operating costs would show a marked reduction for the roads as a whole.

Are you among those who look with "skepticism and distrust" upon forward-looking practices which your neighbors have adopted? Open-mindedness, tolerance, keen perception—these are the virtues of strong men who will come safely through fire and adversity!

A Favorable Maintenance Factor

With equipment maintenance severely curtailed because of the small volume of traffic being offered to the railroads, many freight cars requiring body repairs have been returned to service after receiving much less extensive repairs than would be considered economical under normal conditions. In the effort to keep down expenditures for payroll and material, the minimum of material which will restore the car to a serviceable condition is removed and replaced. In the long run, however, this results in the necessity for a larger expenditure for labor, as the frequent recurrence of the necessity for patching tends to increase the hours of labor required to remove and replace a given amount of material.

In the case of box cars and other cars in the construction of which a large amount of lumber is used, the sharp reduction in the price of material which has taken place during the past two years suggests the advisability of a less restricted expenditure with respect to material, in order that cars may be returned to service for a longer period by a more extensive replacement of material when they are brought into the shops and repair tracks for repairs. Reductions in prices amounting to 40 per cent in the two years has, in some instances, already led to a complete renewal of siding, lining, decking, etc., on cars which, under the higher lumber prices, would have been turned out after receiving the necessary patching to restore them to immediately serviceable condition. If full advantage is taken of this favorable factor a considerable amount of troublesome deferred maintenance may be avoided.

Too Much Technical Literature?

Under the caption "The Flood of Technical Literature," the June, 1931, issue of the Engineering Experiment Station News, which is published monthly by the Engineering Experiment Station of the Ohio State University, points out editorially that there is the feeling among engineers and other scientists that relief is needed from the flood of technical literature on every conceivable subject. Abstracts and bibliographies, the editorial states, are of some help as short cuts, but they are so numerous that abstracts of the abstracts are almost necessary.

There is considerable truth in many of the observations contained in the editorial. The main cause of the difficulty appears to be, it states, not that too many subjects are covered, but that too many people are writing about the same subjects. The editorial criticizes the quality of much of our technical literature, but qualifies its statements by saying that, contrary to the popular belief, engineers are pretty good writers when they report their own work faithfully. About ninety out of every hundred articles on a subject, it says, are just repeat material already published and rehash the conclusions of the other ten.

The editorial concludes with the following statement: "The recent experiment of having only summaries of the papers of a technical meeting presented by official summarizers, giving a more unified picture of the meeting and more opportunity for discussion, looks like a step in the right direction. Perhaps a similar summarizing of the publications in certain fields would help men who have about abandoned the struggle to keep up in their technical reading. Something must be done, and speedily, to afford relief from the flood of technical literature."

The expression of such sentiments, especially in the official publication of an engineering experiment station operated in conjunction with a state university, is indeed a pleasant surprise. Engineering experiment stations can do a lot to relieve the flood of technical literature. Engineering societies can also be of considerable assistance and, fortunately, some of them are beginning to recognize the problem and take suitable steps toward a solution.

However, the solution of the problem is not to be had by placing a muzzle on the engineer who likes to write. Neither will a censor, even though he be given the powers of a Nero. The problem was solved long ago by the responsible technical and business press by classifying circulation and publishing only material known to be of interest and value to subscribers. Thus the waste of effort, paper and printer's ink so heartily

condemned by the Ohio State Engineering Experiment Station News is overcome, at least from one source.

University experiment stations, technical societies, and federal and state technical bureaus and departments can probably do more than anyone else to curtail the flood by a better selection and arrangement of what they publish and by seeing that technical papers and reports are mailed only to those interested in the subject discussed.

Large Car Shop Defended

As was to be expected, the article by B. C. Richmond in the June *Railway Mechanical Engineer,* questioning the economic justification for the large system car-repair shop, has drawn fire. Most of the comments so far received, while admitting the force of some of Mr. Richmond's arguments, take decided exception to his main conclusion. One experienced car department officer says, "Personally I am in favor of the concentration of car work and believe the past practice of attempting to do a lot of *big things* in a lot of *little places* seriously affects the cost of car maintenance." The italics are ours.

In a somewhat belligerent mood, another correspondent maintains that the author of the article "cannot have previously given serious thought and consideration to the importance of economical methods of repairing freight cars, and the vast part it plays in the operating expense of a railroad, since, in his opening paragraph, he suggests that *now,* in this time of depression, the subject of freight-car repairs is one that is worthy of consideration. Certainly the subject of freight-car repairs is never other than one of vital importance."

The article referred to apparently revolves around the idea that the proper cycle of general or heavy repairs for freight cars is 12 years, with probable intermediate repairs at six-year intervals. It naturally follows, therefore, that a large shop cannot be justified, for the reason that not enough heavy-repair cars were available under this program to keep the shop operating at an economical capacity. It has been demonstrated, however, that a lesser shopping period, probably a four-year program, may not only provide an economical cycle of repairs, but also produce an improved general physical condition of equipment and a consequent reduction in bad-order cars that cannot be obtained with a prolonged period between repairs. On this basis, therefore, sufficient cars, requiring heavy repairs, are available to justify handling the work in large shops on many roads.

Instead of providing additional work for light-repair points, as suggested in the article, many car-department officers feel that efforts should be directed to reducing light repair-track work to a minimum, and the concentration at a number of selected repair points of that work which must be performed periodically such as air-brake cleaning, repacking of boxes, reweighing, and draft-gear inspection and repairs, at which time all other necessary repairs can be performed. It is estimated that a program of this nature will reduce the number of movements of cars to repair tracks from between 35 to 50 per cent, with resultant savings in switching, per diem or car-day loss, and other incidental expenses that are incurred each time a car is moved to a light repair track.

One car man contends that the figures set up by Mr. Richmond showing the relative cost of owning and operating one large shop, as against four smaller shops, do not lend themselves to comparison because he is using an excessive cost for the large shop, and an insufficient amount, by comparison, for each of the smaller shops. Apparently he has given insufficient consideration to the organization and general overhead expenses such as lighting, heating, general supervision, maintenance of buildings, material stock, store-department organization, etc., that is necessary for each individual shop which would be considerably reduced by the concentration of work at one point. It is a well recognized fact that concentration of work, allowing mass-production methods to be used, is conducive to lower unit repair costs.

The development of the most desirable car-maintenance policy is, of course, an economic problem of as much difficulty as importance, and must be solved by each road for itself. The provision of one large shop to handle all heavy-repair cars on a railroad of considerable size, is plainly not justified. Certain types of cars must be repaired in the territory where that class of loading originates or in the vicinity of the natural empty movements of the particular cars, so that no extensive back-haul on empty equipment is involved for repair purposes, and railroad operation hampered to that extent.

Square Valves Needed

There are two reasons why the present is an excellent time to give more attention to the condition of valve gears and the setting of locomotive main steam valves: First, the resulting condition of improved maintenance will guard against failures; and, second, the assurance of proper steam distribution will have a desirable effect in reducing fuel consumption and, hence, railway operating expenses. The first feature is always important and the second especially so at the present time as improper valve setting may entail a waste of fuel, in extreme cases, of nine per cent, or more.

Locomotive main steam valves must be square and properly set to give the desired steam distribution, and many able shop executives maintain that this operation of adjusting the valves cannot be performed with the desired accuracy and satisfactory results unless the locomotive is put on rolls in the backshop, dead centers obtained, and all parts of the valve motion adjusted to give the proper valve travel marks with respect to the port marks in both forward and back motion. But before setting the valves, this careful maintenance program should begin with a critical inspection of all valve-motion parts and checking with the blue prints for standard dimensions. Such fundamental dimensions as the distance between the link-trunnion center (Walschaert gear) and the steam port, link radius and radius-rod length, etc., should be standard and should be the same on both sides of the locomotive, a condition not always found to exist. In the interests of interchangeability and economy in shop manufacture, as well as subsequent economy in handling and reduced locomotive out-of-service time, too much attention can hardly be given to maintaining valve-motion parts to standard blue-print dimensions.

Tests have shown not only that the condition of locomotive valve motion vitally affects fuel consumption

but also that valves may sound reasonably square, and yet provide an improper distribution of steam. Among other disadvantages, this usually results in the draft nozzle being choked to give the desired steaming characteristics, entailing increased back pressure and still further increases in unit fuel consumption and reductions in available tractive force. Moreover, the excessive back pressure puts undue strain on piston rods, crosshead bearings, and connections and is often responsible for cylinder-head and piston-rod packing leaks. Distorted steam distribution also sometimes interferes with the proper lubrication of valves and cylinder walls.

A real opportunity exists for locomotive maintenance officers to effect a substantial saving by giving immediate and constant attention to improved valve conditions, and traveling engineers can, of course, assist by promptly reporting to their respective superiors any locomotives, the performance of which is questionable in this important respect.

Train Detentions on Account of Mechanical Defects

The prevention of freight- and passenger-train detentions, on account of mechanical defects is a problem that has always been with the mechanical department. Doubtless it always will be, for up to the present time there has not been a machine built which is so perfect as not to break down sooner or later. We are still awaiting the Utopia in materials that will not break or wear out in machines.

It is because of that knowledge that we strive for the "irreducible minimum" rather than for perfection. Many of us are too apt to consider the "irreducible minimum" as perfection, instead of striving to reduce the irreducible further.

However, this seems to be the objective of a railroad in the east with respect to train detentions. Its car department is working hard for a "No Passenger-Train-Detention Month." In May, 1931, three passenger-train detentions were charged against the car department. This record was spoiled the following month when eleven detentions were due to mechanical defects.

However, this is what the superintendent of the car department had to say to his staff: "Our good showing for the previous month has been defeated. But our objective of no detentions is still before you and it can be accomplished."

This road handles considerable passenger traffic, especially during the summer, and also a large amount of freight traffic from and to the eastern seaboard. In May of this year there were a total of 146 freight-train detentions. This was reduced to 123 in June as compared with 101 freight-train detentions for June, 1930. Hot boxes were the direct cause of 92 of the 123 detentions.

The general car inspector and division car foremen have been instructed to clear with the supervisors at all inspection points on the system and to see that the car inspectors are checked and properly instructed. Cars which are properly inspected at points of origin and all defects corrected should arrive at destination and not cause detentions.

The remedy is obvious to all car-department officers. But sometimes because the remedy is so simple we forget to use it. Strict adherence to the fundamentals of good railroad maintenance, one of which is through inspection, gets trains over the road.

NEW BOOKS

THE DEVELOPMENT OF THE LOCOMOTIVE—TWO VOLUMES. *By Dr. Ing. e.h. R. von Helmholtz and Ministerialrat A. D. W. Staby. Bound in stiff board covers, 8½ in. by 12½ in. Volume I contains 38 drawings, Volume II, 446 pages, illustrated. Published by Verlag von R. Oldenbourg, Munchen and Berlin, Germany*

These two volumes which were compiled under the supervision of the Association of German Railroad Managements to which the railroad managements of Austria, Hungary, Holland and Switzerland belong, are written in German. They contain a comprehensive history of the development of locomotives in the above named countries from 1835 to 1880. The two volumes also contain a large number of illustrations showing the early locomotives built in England, and undertakes to show how the locomotive industry on the continent gradually broke away from the English influence and followed an independent development. The two volumes contain 706 illustrations of various designs and types of locomotives.

LOCOMOTIVES OF THE L.M.S., PAST AND PRESENT. *Published by the Locomotive Publishing Company, Ltd., 3 Amen Corner, London, E. C. 4, England. 52 pages, paper bound. Illustrated. Price $1.*

A broad outline of the development of the locomotives of the London, Midland & Scottish Railway during a period of one hundred years is given in this book. Each of the main constituent companies of the L.M.S.—the former London & North Western; Midland; Lancashire & Yorkshire, North Staffordshire, Furness, Caledonian, Glasgow & South Western and Highland systems and subsidiary companies—is reviewed separately, a few facts of interest regarding the origin and evolution of these companies being given. Numerous illustrations, some of which are in color, show locomotives of outstanding British design which have been placed in service on the L.M.S. since the formal opening of the Liverpool & Manchester Railway in 1830.

PROCEEDINGS OF THE INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION. *Compiled and published by Wm. Hall, secretary, Winona, Minn. 220 pages, 6 in. by 9 in. Bound in black leather.*

A bit of early history of the International Railway General Foremen's Association as presented by E. C. Cook, managing editor of the Railway Journal, before the convention of the association held at Chicago, September 16, 17, 18 and 19, is contained in the proceedings for this meeting which marked the silver anniversary of the founding of the association. The topics discussed were Engine Truck Maintenance and Lubrication; Cost of Material Delays to Locomotives and Cars: Stabilization of Mechanical Shop Forces; Inspection Maintenance and Repairs to Gas-Electric Rail Cars: The General Foreman's Contribution to Fuel Economy, and Better Maintenance of Passenger Car Equipment. The addresses were by President H. B. Sunderman (C. & O.); L. Richardson (B. & M.); J. A. Anderson (C. M. St. P. & P.); William D. Saltiel (City Attorney of Chicago); H. C. Stevens (Wabash), and E. Von Bergen (Illinois Central).

THE READER'S PAGE

Chilled Wheels Worn Through

To the Editor:

There has been a good bit of discussion in your magazine of late about worn-through chill wheels and I feel the urge to express a thought too.

Since the A. R. A. rules have set a condemning limit for removing brake beams with worn heads we think we have discovered a good clew to worn-through chill wheels. If we observe that one brake head shows excessive wear while the other head on the same beam shows little or no wear, we are reasonably sure that we are on the trail of a chill-worn wheel. We think this defect plays a big part in increasing brake-rigging failures, and believe it a good plan to examine closely all cars that have a brake-rigging failure to see that worn-through chill wheels are not the cause.

Jas. McDermon.

What Hot Boxes Mean to a Railroad

To the Editor:

Much discussion has taken place during the past few years regarding hot boxes. In the April, 1931, issue of the *Railway Mechanical Engineer*, a chief car inspector condemns, as he calls it, the wholesale waste of free oil. One man reports that on his railroad cars are oiled as they pass over the hump. I have heard hot-box experts preach on, "How to Stop Hot Boxes," and proclaim, "If oilers can't stop hot boxes, get men who can." In hiring new men you are encouraging more hot boxes.

For about one year, I personally inspected practically all the boxes on trains which were giving much trouble on account of hot boxes. My best plan has been to organize the oiler forces and to know that each man is willing to do the best he can as instructed. When going along the train, the inspectors make sure that each bearing is in good condition and that the journal is properly lubricated. If found to be dry, the packing is raised to the proper height with the iron according to Rule 66. If the journal and waste are found to be dry, a small amount of free oil is necessary. This oil should be applied on the feeding side of the journal.

I have kept notes of heavy loads such as stone, oil and machinery, and of cars having new brasses, and new wheels to determine just what cars were causing trouble. During a two-month's hot-box epidemic in 1930, about 500 boxes were jacked in train yards on account of waste grabs caused by cars being switched over the hump. In every instance the waste grab was removed by cleaning the journal and bearing and then re-applying the same bearing if no other mechanical defects were found. Only one out of the 500 on which notations were made developed a hot box.

Some months were consumed after Rule 66 was adopted in getting cars so that the packing was at the proper height. When trains move week after week without a hot box, it might be the wiser plan to praise the oilers rather than to criticize them for wasting a little free oil on cars when passing over the hump. The men in the train yards like to see trains move on schedule with as little mechanical delays as possible. They know as well as anyone else that the speedy movement of trains means revenue to the railroad.

J. W. McClellan.

"Mallet" Locomotives and Speed—Some Criticisms

To the Editor:

In the chart on page 230 of the May issue there is a reference to "simple Mallet" locomotives. On page 231 the same engines are described as the "heaviest Mallet" locomotives. In view of the sentiments expressed by you some time ago, why not be consistent and refer to these as "single-expansion articulated" locomotives?

On page 240 you have repeated the erroneous claim that the Great Western locomotive, "City of Truro," was "the first form of locomotion" to pass the 100-m.p.h. mark. This claim is based on a stop-watch timing of a quarter mile in 8.8 sec. on May 9, 1904. Much higher speeds were repeatedly sustained over considerably greater distances by the two large electric cars tested on the Prussian military railway between Marienfelde and Zossen in the autumn of 1903. On October 28 of that year the car built by the Allgemeine Elektricitats Gesellschaft reached a velocity of 130½ m.p.h. Though the length of line available for the tests was but little more than 14 miles, necessitating most of the running time being devoted to accelerating and braking, it was found possible on several occasions to run at speeds in excess of 120 m.p.h. for four consecutive miles. These figures were recorded by accurate mechanical means, beyond the shadow of a doubt, and they cannot be approached by any type of reciprocating steam locomotive.

As you probably know, the World Almanac contains a table of fast railway runs over short distances in America, the speeds claimed varying from 102 to 120 m.p.h. It is obvious that most of these runs were not accurately timed and that they are all ignored by Englishmen, as might be expected.

Wm. T. Hoecker.

In Defense of Master Mechanic

To the Editor:

I have read with great interest the original letter of Master Mechanic in the February issue of the *Railway Mechanical Engineer* and the comments on his letter in succeeding issues.

I wonder what type of master mechanic would make a written statement of that kind unless he at some time had an experience with foremen's organizations that had set his mind against them. I think the cause will be found in the statement, "The objectionable feature of personal gain has a place in their meetings," which is made in the fifth paragraph of the letter en-

titled "Master Mechanic Wrong About Foremen's Organizations" which appears on page 246 of the May issue.

Foremen who have personal gain uppermost in their minds are very apt to make indiscreet remarks about the other fellow's business, and it seems as though they like to save it up and shoot it at a meeting or in a crowd in order to make an impression leading to the belief that they are the originators of the idea. In other words they have a disease called "Big I." If the letter "I" were taken out of the dictionary, he would have to learn English all over again.

Now it often happens that something goes wrong in a master mechanic's work. A mistake is made; the master mechanic knows about it, we will say, and is doing all he can to correct it. But before he can do it the "Big I" foreman shoots it at the meeting, to the embarrassment of the master mechanic and his foreman's organization. When he is doing this he should know that he is butting into the master mechanic's business and that he would be disgusted if he were in the master mechanic's position.

Now, Mr. Foreman, we know you are not the "I" type of foreman and we say by all means let's have meetings, but let's stick to such subjects as you mentioned and be good sports and treat Master Mechanic's personal business with him privately and not at meetings. I am betting he will change his opinion of us and be a booster.

TOM DE MOND.

Wanted—A Definition For Progressive and Spot Systems

TO THE EDITOR:

There appears to be considerable confusion as to what is meant by the terms "Progressive System" and "Spot System" of car repairs. Definitions of these two terms do not appear in the "Car Builders' Cyclopedia".

I have always defined the progressive system of car repairs as the system in which the men, tools and materials are moved from car to car on the repair track. The car is not moved from the time it is placed on the repair track until all repairs are made and the car is switched out. All repairs, except possibly painting, are made on one spot in the shop.

The spot system of car repairs, I have always defined as the system in which the cars are moved from spot to spot; for example, stripping is done on spot No. 1, truck repairs on spot No. 2, underframe repairs on spot No. 3, etc.

Am I wrong or am I right? What are the correct definitions of these two terms?

READER.

What About a Slow and Quick Release Valve?

TO THE EDITOR:

"What about a slow and quick release valve coupled to the exhaust port in the triple valve and the release-valve opening in auxiliary reservoir, doing away with retaining valves?" A valve of this type could be set at 60 lb. auxiliary-reservoir pressure to operate it in quick-release position. If the train is descending a grade, the engineman will make the desired reduction, then move the brake valve to running position only, and slow release would take effect until a pressure of 60 lb. had been obtained in the auxiliary reservoir. Quick release could be obtained by building up the auxiliary reservoir pressure quickly.

SUPERVISOR.

An Answer

TO THE EDITOR:

The present type of feed valves placed on modern locomotives are of high capacity. It would be impossible, regardless of the capacity of the feed valve or compressor, to raise the pressure uniformly throughout a long train. Obviously, the auxiliary-reservoir pressure, for this reason, cannot be built up quickly as is the opinion of "Supervisor."

To give the idea of the difference in time of build-up of brake-pipe pressure, the following data was secured by a recent check. The train consisted of 99 cars.

Time of build-up on head end

40-70	lb.	10 sec.
68-69	lb.	1 min. 55 sec.
69-70	lb.	1 min. 10 sec.
Total	time	3 min. 15 sec.

Build-up on rear end

50-55	lb.	1 min. 25 sec.
55-60	lb.	1 min. 37 sec.
60-65	lb.	1 min. 50 sec.
65-68	lb.	2 min. 07 sec.
Total	time	6 min. 59 sec.

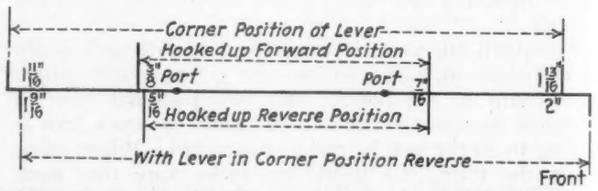
From this information, it is observed that there is a vast difference in the time of build-up of pressure as between the head and rear ends.

AIR-BRAKE SUPERVISOR.

Setting Walschaert Gear—A Question

TO THE EDITOR:

We have an engine with a Walschaert valve gear which shows a valve-stem reading on running over like that shown in the sketch. Both sides show the same



Valve was squared with reverse lever and link block on center—What change is required to square the valve?

port dimensions. The valve was squared with the reverse lever and the link block in the center position. Where would the change be and what changes in the gear are necessary to square the valve?

ARTHUR E. MYLIN.

* * *

Modern car wheel shop and wheel storage tracks on the St. Louis-San Francisco at Yale, Tenn.

With the

Car Foremen and Inspectors

Handling Wheels and Axles on the C. & A.

By H. C. Myrick *

AT the time the wheel and axle shops of the Chicago & Alton, Bloomington, Ill., were laid out, considerable study was given to the placing of machines and material where each would operate as a unit, and follow through the different operations with the least handling possible, from the receiving of the wheels and axles from the foundries to the shipping of the finished product. With this idea in mind, the first thought was the rolling of wheels and the danger connected with it. A 3-in. concrete floor was laid, and on top of this were laid 3 in. by 4 in. by 6 in. creosoted blocks. This floor has proved satisfactory, both in maintenance and ease when rolling wheels. The blocks are easily replaced when they wear out. All the blocks are cut in the planing mill, and thus a supply is easily maintained.

The building is heated with steam taken from the exhaust of the steam hammers in the blacksmith shop, adjacent to the wheel and axle shop. Radiators are placed along the north and west walls, which have the most exposure, and the building, which is 57 ft. by 177 ft. is kept at a comfortable temperature.

* Mr. Myrick is air brake foreman of the Chicago & Alton, Bloomington, Ill.

The micrometer system is used in the boring of wheels to axles. All new axles are turned to standard A.R.A. gage. All steel wheels are dismounted and remated if ¼-in. or more must be turned off the tread to restore a full flange.

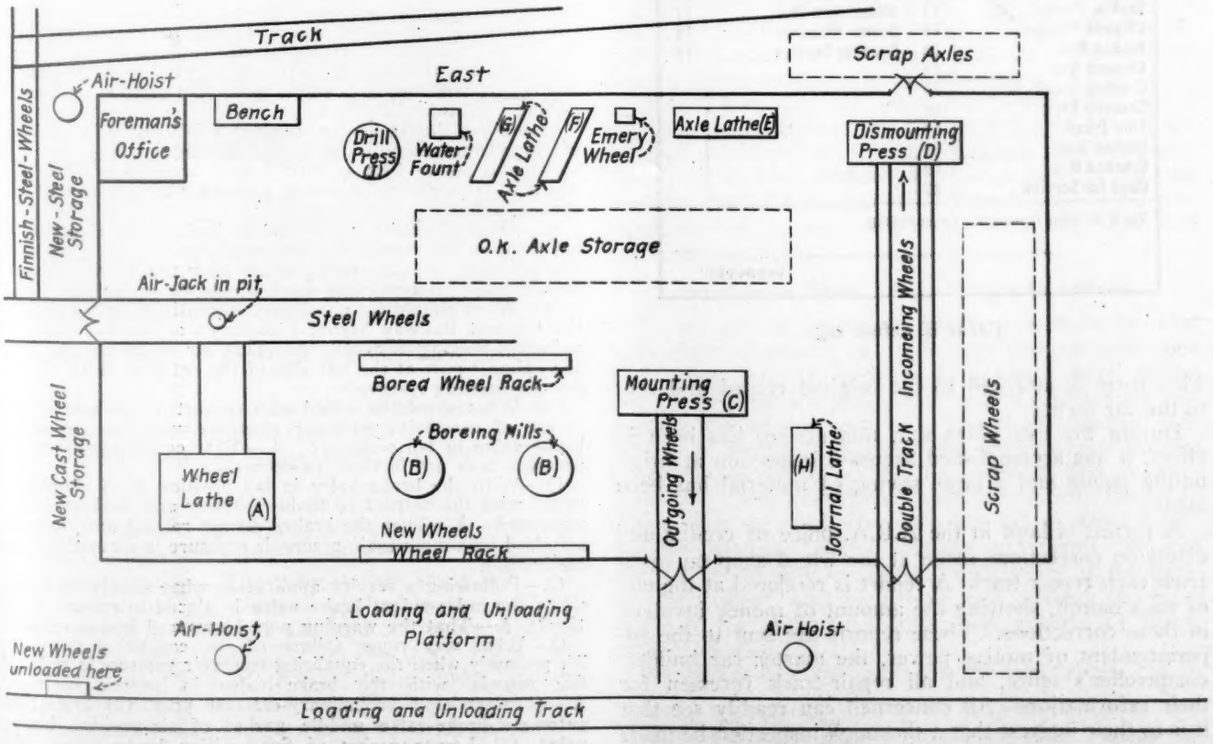
All the wheels and axles for the entire C. & A. system are worked in this shop, and are loaded on wheel cars built especially for this class of material. A list of the tools and equipment with reference to their location in the shop is shown in the table.

List of Machine Tools Used in the Wheel and Axle Shop of the Chicago & Alton, Bloomington, Ill.

Ref.	No.	Size	Tool
A	1	42 in.	Niles Wheel lathe
B	2	42 in.	Niles Single-bar boring mills
C	1	300 ton	Niles Single-ram mounting press
D	1	400 ton	Niles Double-ram dismounting press
E	1	12 in.	Niles Double-end axle lathe
F	1	10 in.	Niles Double-end axle lathe
G	1	16 in.	Niles Single-end lathe for engine truck axles
H	1	36 in.	Niles Single-end lathe for truing journals on mounted wheels
I	1	36 in.	Niles Emery wheel
J	1	4 ft.	Niles Radial drill press

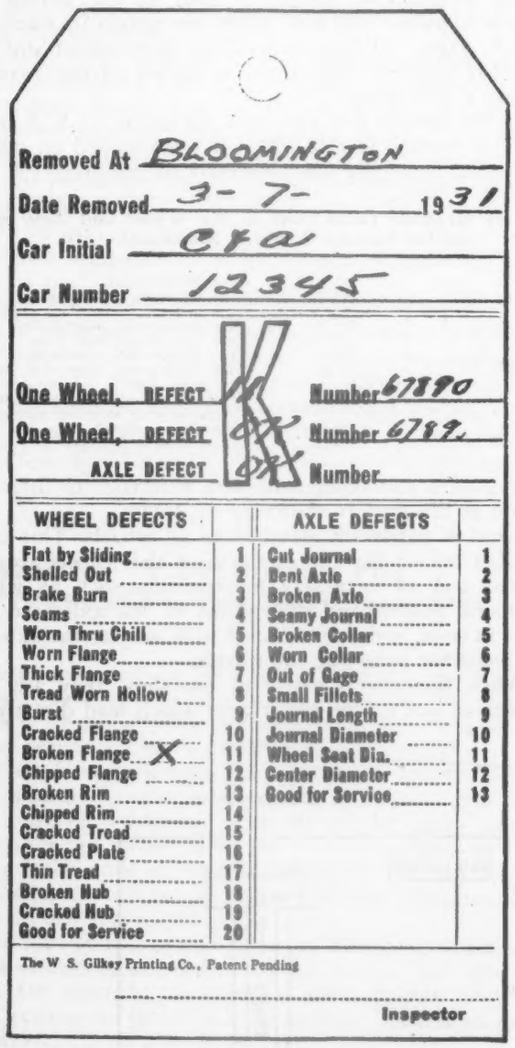
Form K cards are attached to all wheels. This card is filled out at the car at the time the wheels are removed and all necessary information, such as wheel numbers, defects and dimensions of the axle, are applied in code, and then secured with wire to the axle by the inspector removing the wheels.

When the wheels arrive at the shop, they are unloaded on one of the two tracks which lead directly to



Machine-tool and equipment layout of the wheel and axle shop of the Chicago & Alton at Bloomington, Ill.

the dismounting press, where they are inspected, and the Form K card is checked against the defects marked. If the defects are not found to be as the card indicates, corrections are made, and the card is signed by an inspector, who in turn notifies the foreman in charge, who also makes an inspection. The corrected form is then sent to the A.R.A. office, which sends a corrected form to the station where the wheels were removed.


Removed At BLOOMINGTON

Date Removed 3-7- 1931

Car Initial C&A

Car Number 12345

One Wheel, DEFECT Number 67890

One Wheel, DEFECT Number 6789

AXLE DEFECT Number

WHEEL DEFECTS		AXLE DEFECTS	
Flat by Sliding	1	Cut Journal	1
Shelled Out	2	Bent Axle	2
Brake Burn	3	Broken Axle	3
Seams	4	Seamy Journal	4
Worn Thru Chill	5	Broken Collar	5
Worn Flange	6	Worn Collar	6
Thick Flange	7	Out of Gage	7
Tread Worn Hollow	8	Small Fillets	8
Burst	9	Journal Length	9
Cracked Flange	10	Journal Diameter	10
Broken Flange X	11	Wheel Seat Dia.	11
Chipped Flange	12	Center Diameter	12
Broken Rim	13	Good for Service	13
Chipped Rim	14		
Cracked Tread	15		
Cracked Plate	16		
Thin Tread	17		
Broken Hub	18		
Cracked Hub	19		
Good for Service	20		

The W. S. Gilkey Printing Co., Patent Pending

Inspector

Form K defect tag

This form is attached to the original record and sent to the car owner.

During the five years that this system has been in effect, it has accomplished accurate inspection at originating points and a large saving of material has been made.

A record is kept in the A.R.A. office of credits and debits on corrections made at the wheel shop on cards from each repair track. A report is rendered at the end of each month, showing the amount of money involved in these corrections. These reports are sent to the superintendent of motive power, the master car builder, comptroller's office, and all repair-track foremen for their information. All concerned can readily see that it is to their interest that a thorough inspection be made on all wheels and axles before final disposition.

Questions and Answers For Air Brake Foremen

FOLLOWING is the second group of questions and answers selected from the instruction pamphlet recently revised by an eastern road:

Q.—What may cause leakage from the exhaust of a straight-air brake valve with brakes released? A.—Defective application valve.

Q.—What may cause leakage from the service-exhaust port of all automatic brake valves in running position? A.—A defective equalizing-discharge valve or dirt or scale on its seat, also middle gaskets leaking on the K-12 brake valve.

Q.—What may cause leakage from the exhaust port of a quick-action triple valve? A.—A defective triple valve, slide valve stuck, closed, or defective obstruction in feed-valve or triple-valve gaskets.

Q.—What may cause leakage at the brake-cylinder exhaust of a distributing valve with the brakes released? A.—A defective application valve, equalizing-cylinder-cap gasket, distributing-valve gasket or emergency-slide valve when a quick-action cylinder cap is used.

Q.—What may cause leakage at the exhaust port of a brake-pipe vent valve? A.—Defective emergency slide valve, lower gasket or rubber seat of the vent valve.

Q.—What may cause brakes to fail to release following a service, independent, or straight-air brake application with the automatic brake valve in running position? A.—Feed valve stuck, closed, or defective; obstruction in feed-valve pipe or bracket, or in the distributing-valve release or application-cylinder pipe; defective equalizing or application portion of the distributing-valve; brake-cylinder exhaust obstructed or defective triple valve.

Q.—What may cause the brakes to remain applied when the brake-cylinder pressure is exhausted? A.—It may be caused by foundation brake gear members fouling or binding or by a weak or broken brake-cylinder release spring.

Q.—How will a sluggish feed valve and brake-pipe leakage combined effect a release of the brakes, after an independent or straight-air brake application when the independent brake valve or straight-air brake valve is placed in release position? A.—Brakes may fail to release.

Q.—Will the defect in the preceding question effect a release of the brakes with No. 5 E. T. Equipment? Why? A.—No, because the release of the brakes is effected through the application-cylinder pipe.

Q.—What should be noted when a 5-lb. service reduction in holding position and the independent brake valve in running position? A.—That brakes do not release except when the holding feature is not maintained.

Q.—How is the holding feature eliminated? A.—On steam engines by elimination of the U pipe. On electric engines by milling the brake valve rotary.

Q.—What should be noted when a 5-lb service reduction of equalizing-reservoir pressure is made? A.—That the equalizing piston lifts promptly, that brake-pipe air is discharged through the standard exhaust fitting and that the brakes apply.

Q.—What should result when the brake valve is placed in lap position after reducing the equalizing-reservoir pressure five pounds? A.—Discharge of air from the service exhaust should cease promptly and there should be no leakage.

Q.—What should be noted on locomotives equipped with the General Railway Signal Company's automatic stop and reduction-limiting feature? A.—That air is discharged from the exhaust port at the left side of the actuator from the reduction-limiting reservoir.

Q.—What should be noted with respect to increase or decrease of equalizing-reservoir pressure with the automatic brake valve in lap position? A.—That equalizing-reservoir pressure does not increase or decrease.

Q.—With the brake valve in lap position what should be noted with the respect to main-reservoir and brake-cylinder pressure? A.—That the brakes do not release and that the standard maximum main-reservoir pressure is secured on the locomotive.

Q.—Following a service application what should be noted when the independent brake valve is placed in release position? A.—That the warning port blows and brakes release.

Q.—What may cause failure of the equalizing piston to lift promptly when the equalizing-reservoir pressure is reduced five pounds, with the brake valve in service position? A.—(1) Restricted preliminary-exhaust port. (2) Defective automatic-brake-valve middle gasket of six-position brake valve. (3) Lower gasket of five-position brake valve. (4) Equalizing piston or ring leaking. (5) too tight.

(6) Excessive brake-pipe leakage. (7) Broken spring of collapsible-type equalizing piston. (8) A worn automatic-brake valve rotary keyway. (9). Worn handle. (10) Worn post.

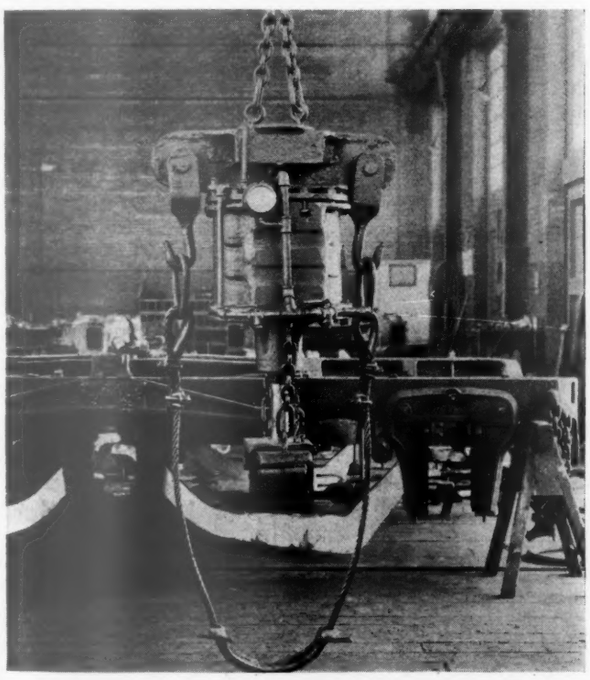
Q.—What may cause failure to discharge air at the service exhaust port of an automatic brake valve in service position when the equalizing-reservoir pressure is reduced 5 lb. at service rate? A.—It may be due to an obstruction in the service exhaust or fitting and a worn cam or worn brake-pipe exhaust-valve stem or missing steel tip K-12 brake valves.

Q.—What may cause leakage from the service exhaust with the automatic brake valve in lap position? A.—Usually indicates a leak from the equalizing reservoir or its related piping or the tube in the gage, a defective equalizing discharge valve or scale in the seat.

Q.—Name some causes of an over-charged brake pipe which may prevent the equalizing piston from raising? A.—Dead-engine fixture cut-out cock open and defective check valve, defective automatic rotary valve or seat.

Elliptic Spring Remover

ONE of the most effective labor-saving devices in the passenger car shops of the Union Pacific at Omaha, Neb., is the device illustrated for removing the elliptic springs from passenger-car trucks.



Labor-saving device for removing and applying truck springs

The device consists of an air cylinder, bolted to a cast-steel yoke suspended from the shop crane, and equipped with suitable hooks, cable, and air-operating valves.

In use the air cylinder is moved by the crane over the truck until the piston and plunger are in line with the center plate, or cross-frame member in the case of six-wheel trucks. The cable is then slung under the spring plank and air pressure applied in the cylinder. As the piston and plunger are held stationary with respect to the floor by bearing on the truck frame, the action has the effect of pushing the cylinder upward which raises the cable and spring plank, permitting the equalizers and spring hangers to be taken down and the truck completely dismantled.

This method has an advantage over the use of the shop crane alone, as there is no danger of lifting the entire truck frame off the horses. In shops unequipped with crane facilities, the device illustrated has the distinct advantage of making it unnecessary to jack up the spring plank or apply clamps to the individual elliptic springs. It results in a substantial saving in man-hours of labor in connection with truck work, and repair work is proportionately expedited.

Car Shop Safety Devices*

By F. B. Lewis †

SEVERAL safe and efficient devices are in use daily for handling of couplers and gears at the Armstrong shops of the Union Pacific, Kansas City, Kan. Virtually no lifting is required on the part of the operator. Hundreds of coupler operations are handled without an injury and without much hazard of one.

Our coupler trucks are so arranged that we can stand a yoke coupler on end, turn the truck up to it, hitch the chain, and tip the truck and coupler back into the wheeling position, then wheel the coupler into place directly under the draft arms. The coupler rides on a revolving jack so it can be turned around on the truck and a few strokes of the jack raises it into place in a few seconds with no danger of it falling off the cradle on the jack head.

Our long tongue truck for heavy draft gears enables us to take the gear from the ground to position in the draft arms without any lifting or danger of dropping.

After the installation of an annealing furnace in the shop, we were confronted with the particularly arduous and dangerous work of handling heavy truck sides and bolsters into the furnace for annealing. It was necessary to stand quite close to the furnace to handle the heavy material. The heat of the furnace with the door open, presented a very discouraging aspect on a hot summer day. Several near accidents occurred.

The ingenuity of the shop was called upon and a traveling furnace charging device actuated by an air cylinder was constructed, permitting one man to handle the work of four without exertion. Best of all, the operator placed himself out of harm's way as he manipulated the device—well away from the heat and the heavy material.

Ingenious Rivet Chute Stops Dizziness

We noticed the tendency of some men to be troubled with slight dizziness, or spots appearing before their eyes, when they are required to perform work calling for continuous stooping over and straightening, especially during hot weather. This was especially annoying to riveters. A chute-like arrangement pivoted to permit moving in a large arc, was devised to overcome this. The heated rivets are thrown into the chute where they are available, with the aid of short tongs, without stooping over. Similar provisions for enhancing safety may be seen in every phase of the steel-car department, and were developed through the ingenuity of the men, to promote the welfare of themselves and others.

We find it desirable to retain the top step on our 8-

* From a paper presented before the A.R.A. Safety Section annual meeting at Chicago in May, 1931.

† Mr. Jones is general car foreman of the Union Pacific at Kansas City, Kan.

ft. and 12-ft. "A" ladders for convenience in using tools, etc., but we do not permit men to stand on the top step for any purpose. All tops are kept painted yellow as a reminder to the employee against the possibility of forgetting for a moment that he must not put his foot there. It is only to brace his leg against, or use as a shelf.

While the general rule to withdraw or turn down nails is enforced in all detail operations, there are frequently cases where the entire side of car, or the roof, have to be ripped off, and the safe and efficient practice is to rip it all off quickly, then pile back till it can be hauled away. Any car foreman knows that this operation as well as some others involves a temporary hazard of stepping on nails. So we instituted the practice of periodic shoe inspection, and forbid a man from continuing at work in thin-soled or badly worn shoes. As a result we have a well-shod bunch of workmen and have had no nail punctures in a long time.

When any heavy parts are to be lifted or handled any place or any time, requiring several men, they have standing instructions to get enough help so that one man—usually the senior man or leading workman—will be free to boss the job, call all moves and watch the footing, etc. This makes for harmony of movement and is an effective safety precaution.

We require that goggles be worn when nailing or pulling nails, or when in close proximity to men so engaged.

The shops and grounds are of course kept free of scrap material. Nothing induces safe operation more than clean shops and repair tracks. Recently a complaint was received from the switch crew who switched car-repair tracks, that they could find nothing in the nature of scrap wood to block the cars. All our regular sawed car blocks had been carefully picked up and put in the tool house. Needless to say, we now provide a keg of small blocks convenient for the switchmen to use when setting our cars at night.

Jacking blocks are provided in sizes of sufficient thickness to insure a proper jack foundation. Small blocks are also supplied to be used under heads of jacks where there would be a metal to metal contact. Short tongs are furnished to each gang for the purpose of handling journal wedges and bearings to eliminate the occasion for placing the hands in the journal box. Longer tongs are used to handle center pins.

Accidents Will Happen

I wish I might say that, as the result of the attention given over to the humanitarian side of our shop and the splendid co-operation that exists, we have never had an injury and will continue to function forever without one.

But the idealist who dreams of a state of perfection is likely to have his dreams shattered if he fails to make allowances for the fallibility of man.

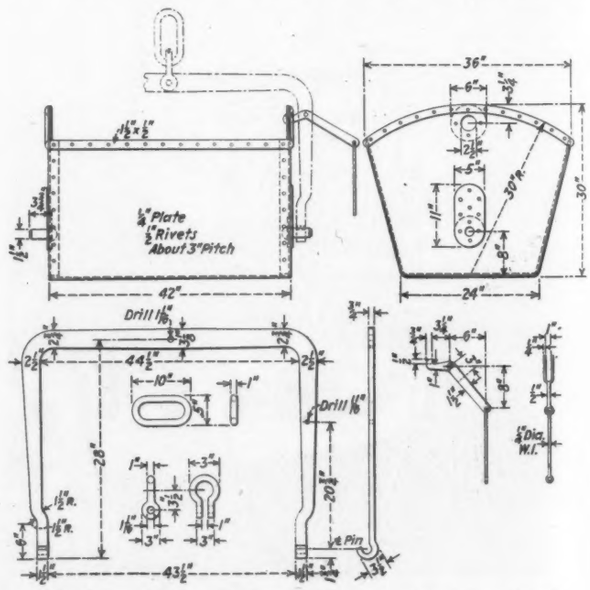
After basking in a supposed state of perfection, without a lost-time injury among 300 men for a period of just under three years, February 13, 1931, found our shop charged with an accident. One of our older employees, who was regarded as a careful worker, long accustomed to the hazards of wood-working machinery, had the misfortune to severely lacerate his forearm on a motor-driven saw. A small socket wrench, not essential to the work at hand, had been misplaced. He and the machine hand helping him decided to waste no further time in an effort to locate it. Just as the machine hand turned to start the saw, the injured man saw the wrench through an opening in the guard, under the saw table. He raised the guard and reached with his hand under the circular saw to grasp the wrench just as the saw started.

Sight of the lost wrench had galvanized him into action, and in his eagerness to recover it, he forgot the saw was to be started. I question who suffered the most from the calamity, the injured man or the 322 shop men whose three-year perfect performance had come to grief.

I would summarize these observations on car-shop and repair-track safety, by saying that safety only reaches mature growth in an atmosphere of honest intention and trained thinking. It is but a dwarf plant if nourished only on artificial safeguards and perfunctory interest; it blossoms in the full light of personal responsibility borne by each man, whether workman or supervisor; its fruit is the happiness shared by every home when the year's record is "clear."

Side-Dump Bucket For Removing Refuse

REMOVING refuse and scrap from around a car yard or shop and doing it efficiently is one of the essentials of good housekeeping. The side-dump bucket shown in the drawing was designed and has been



Side-dump bucket designed for use with crane truck or traveling hoist

used for the past four years by one railroad for just that purpose.

It is of light construction and may be used with a crane truck if desired. The bucket is of ¼-in. plate secured with ½-in. rivets. It can be easily made in the sheet-plate mill. The other parts can be made in the forge shop.

THE ST. LOUIS-SAN FRANCISCO reports that in January, when 4,233,170 passenger train-miles were operated, 97.8 per cent of its passenger trains were on time, while in February, 97.6 per cent were on time. During these months, there was not a single hot box reported on passenger-train cars or locomotives. There were only 81 hot boxes charged to freight equipment in January, and only 61 in February.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Unnecessary To Specify Why Air Brakes Are Inoperative

The air brakes on Baltimore & Ohio car No. 106646 were cleaned by the New York, New Haven & Hartford at Maybrook, N. Y., November 30, 1928, and bill rendered against the B. & O. for cleaning, oiling, testing and stencilling the cylinder and triple valve, cleaning the retaining valve and applying one new 8-in. Kendall packing cup, the charges totaling $5.08. On June 11, 1929, the B. & O. wrote to the New Haven, taking exception to the bill and attached a joint evidence statement dated January 11, 1929, which stated "Air brakes inoperative," contrary to 60-day limit provided by Rule 60. The New Haven declined to honor the B. & O. exception on the ground that it should state definitiely the defective condition which occasioned the subsequent cleaning by the car owner, referring to the third paragraph of the answer in Interpretation 2, Rule 60, as the grounds for its contention that it is mandatory to state definitely the reason which caused the air brakes to become inoperative. The B. & O. referred to the report of the Committee on Prices for Labor and Material in 1918 which recommended the adoption of an average credit price to cover the cost of cleaning and repairing triple valves as "The proposed average charge will eliminate a lot of complicated records." In keeping with this recommendation the B. & O. maintained that it is impossible to furnish information as to the cause of inoperative triple valves at the time and place they are removed and that records for following the valves to repair shops for billing purposes were abolished at the time the above rule was adopted.

The Arbitration Committee decided that "It would be impracticable to follow individual triple valves to test rack to ascertain cause for failure to function. Information that air brakes were 'inoperative' is sufficient in such cases. The contention of the New York, New Haven & Hartford is not sustained."—*Case No. 1666, New York, New Haven & Hartford vs. Baltimore & Ohio.*

Ship-Lap Can Be Substituted for Tongue-and-Groove Material

On June 6, 1929, the Northeast Oklahoma applied 58 pieces of decking and 14 pieces of end lining to Michigan Central car No. 80506. Ship-lap material was used and the decking was gained out for the riveted heads on the underframe with an adz. When the car arrived on Michigan Central rails, August 16, 1929, a joint evidence was taken covering the 1¾-in. ship-lap lining in place of the 1½-in. tongue-and-groove lining, and the ship-lap flooring, not properly framed, laid, or bolted, in place of tongue-and-groove flooring, which the Michigan Central submitted to the Northeast Oklahoma, demanding defect card for labor and material. The Northeast Oklahoma offered to furnish defect card for labor only, but declined responsibility for material. The Michigan Central's demand for a defect card for both labor and material was based on the contention that the shrunk and warped, wrongly bolted and improperly gained lumber which had to be removed because of its shrunken condition to make a grain-tight car was not fit for reapplication partly because of its condition and partly because it was ship-lap, whereas the standard of the Michigan Central is tongue-and-groove lumber for lining and decking. The Northeast Oklahoma maintained that the ship-lap material was A.R.A. standard, that it was properly applied to protect the lading of fine sand-like ore which was loaded in the car following the repairs, but was willing to assume responsibility for excessive moisture content causing the floor boards to spread after they dried out.

The decision of the Arbitration Committee was as follows: "Repairing road is responsible to the car owner for the material as well as the labor used in correcting wrong repairs covered by the joint evidence. In this connection, however, the substitution of A.R.A. standard ship-lap flooring for tongue-and-groove flooring of same thickness, or vice versa, would not be improper repairs if fitted tightly and properly framed and bolted. In gaining floor planks for rivet heads, etc., it is important that this be done in a workmanlike manner so as to avoid unnecessary weakening of planks."—*Case No. 1667—Michigan Central vs. Northeast Oklahoma.*

Confine Bills for Fire Damage to Defect Card Items and Associated Parts

On November 4, 1928, F.G.E. refrigerator car No. 25787 loaded with oranges and grapefruit under refrigeration was delivered by the Clinchfield Railroad to the Chesapeake & Ohio at Elkhorn City, Ky. The joint inspector at that point issued a Clinchfield defect card to cover damages to five roof boards, twelve end sheathing boards, one entire felt lining, two end posts, one end-sill filler, and thirteen inside lining boards damaged by fire. On February 25, 1929, the car was repaired at Sedalia, Mo., by the Missouri Pacific and charges amounting to $284.99 were billed against the Clinchfield. In addition to the specific items of unconcealed damage listed on the defect card, the bill covered considerable material such as blind siding, side sheathing boards, side lining boards, roof boards, side fascia, rack rails, side-ladder, grab-iron and sill-step bolts, etc., as well as insulating materials, paint, varnish and nails applied to the sides of the car between the corner posts and door posts amounting to $176.49 to which the Clinchfield took exception, maintaining that they were not associated with the repairs necessary to restore the parts specifically covered by the defect card. The Clinchfield supported its claim that it was responsible only for unconcealed damage by the facts that the car had been accepted by five different railroads, including the Missouri Pacific itself, between the time the defect card was issued and the time it was finally repaired, that it had no record of how the car was damaged and no record of any damage to the contents of the car as the result of the fire. The Missouri Pacific contended that a considerable number of the contested items could not be considered as concealed, since the Clinchfield included in its defect card one entire felt lining which required renewal from door post to door post, necessitating the removal and replacement of an extraordinary amount of lining and siding. The Clinchfield maintained that it was unnecessary to make such extensive repairs to restore the damaged portion, which was confined between the corner posts at the A end.

The Arbitration Committee rendered the following decision: "While in original construction of car the

inside course of hair felt was applied in one piece from door post to door post and against the outside course of insulation was applied waterproof fabric between door posts, it is, nevertheless, common practice in repairs to splice insulation at corner posts which it is believed can be done in such manner as will not impair insulating value to the car. The bill should, therefore, be confined to the cost of renewal of damaged items covered by defect card and the associated parts necessary to renew in connection therewith on above basis."—*Case No. 1668, Clinchfield vs. Missouri Pacific."*

Damage by Cars Parting and Running Together

Ft. Smith, Subiaco & Rock Island car No. 50 was delivered to the Missouri Pacific at Paris, Ark., on October 27, 1925, empty and offered back to the owner at the same point loaded with coal two days later. It was held up by the owner for transfer on account of a broken body bolster. At the Paris yard, the joint terminal used by both the Subiaco and the Missouri Pacific, while undergoing transfer by the car owner the car, after the load had been partially transferred, was set on another track by a Subiaco crew, ahead of four loaded cars destined for road haul on the Missouri Pacific Lines. During a switching movement by a Missouri Pacific engine and crew incidental to getting these four cars out for train make-up, 12 cars in a cut broke in two on account of a low drawbar on the Subiaco car, the cars subsequently running together and knocking the end out of the car in question. The Missouri Pacific contended that inspection of the car showed both wood and metal sills broken because of decay or corrosion, the metal sills, bolster and broken end sill showing old breaks. It claimed that the car was not subject to any rough handling. The Ft. Smith, Subiaco & Rock Island following this damage elected to dismantle the car, billing the Missouri Pacific for the total depreciation cost to the amount of $975.90, claiming that, although the yard is jointly operated, the fact that the damage was done while the car was being moved by the Missouri Pacific crew establishes that road's responsibility, while the Missouri Pacific maintained that under the joint operating arrangement the fact that the engine and crew of one or the other of these roads was moving the car had no bearing whatever on determining responsibility for damage to it.

In its decision the Arbitration Committee stated that "Car was not damaged under any of the unfair conditions of Rule 32. Car owner is responsible."—*Case No. 1669, Missouri Pacific vs. Ft. Smith, Subiaco & Rock Island.*

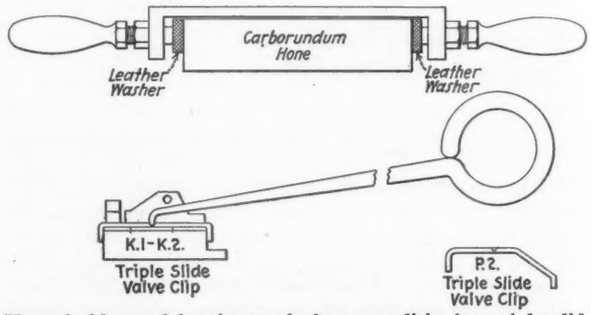
Honing Slide Valves and Seats

THREE clips made of galvanized iron were shown in an article describing a number of tools for repairing triple valves, which was published in the January, 1931, issue of the *Railway Mechanical Engineer*, page 37. Since the publication of that article, several readers have made inquiry as to the purpose of the clips.

They are used for holding Carborundum hones when truing slide valves and slide-valve seats. Honing is gradually becoming a practice in many air-brake repair departments in preference to filing. It permits the reconditioning of slide valves and seats with a minimum loss of metal and eliminates the use of grinding compound for grinding a fit between the slide valve and its seat.

The clips shown at the upper right of the drawing on page 37 of the January issue are used for honing the graduating slide valve of K-type triple valves while the valves are being lapped on their seats.

The clip shown below the two clips referred to in the preceding paragraph is used for honing the slide valves



Hone holder and lapping tools for reconditioning triple slide valves and valves

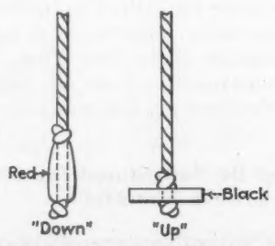
of P-2 type triples. This clip is shown in the lower right of the sketch.

The sketch shows the holder for the carborundum hone. The point of the clip handle is placed in the hole which is made with a center punch as shown in the drawing in the January issue. The dimensions for the handle for the clips are also shown in the drawing showing the clips and other tools.

Designated Controls For Hoists

TO designate the "Up" and "Down" movement of the hook on hoists having the pendant control, special handles were applied to the pendants on all hoists on an eastern railroad.

As shown in the illustration, a file handle, painted red, is attached to the pendant controlling the downward movement of the hook, while a handle placed in a horizontal position and painted black controls the upward movement. The horizontal handle can be made from a discarded hammer or maul handle. In some states the designation of pendant controls is mandatory in the interest of accident prevention.



The red and black handles, in different positions, make it easy to assure the right move on a hoist

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DURING MARCH, 1931, the Missouri-Kansas-Texas, for the first time in its history, operated an entire month without an engine failure. The total mileage of all locomotives in service in that month was 930,610.

Florida East Coast locomotive No. 812 equipped with ellipsometer

Setting Valves On The Florida East Coast

By Wm. H. Bohen*

IT is a well-known fact that to secure a high overall efficiency and a low fuel consumption on a locomotive one of the most essential things is a well-designed valve gear. It is also true that this valve gear must be kept in good condition and set properly if our desire for a smooth running and economical engine is to be realized. The good effects of the superheater, the Thermic syphon, the feedwater heater, the exhaust-steam injector, and efficient firebox and front-end arrangement can all be lost by faulty valves. As a small variation from the correct relation of one valve event to another will cause a considerable increase in steam consumption, it is well to have a record of the actual relations when the locomotive is under steam. With such a record available it is possible to determine just what alterations must be made to secure the proper valve event relations with the minimum amount of work.

The "valve ellipse" may be defined as a graph which shows the position of the valve with respect to the piston for all points of the piston stroke. On account of the angularity of the main rod and the design of the valve mechanism, such a graph will not form a true ellipse of the equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

It is called an ellipse because in appearance it resembles a true ellipse.

Let us consider the graph diagram shown in Fig. 1. Distances in the y direction give us positions of the valve from the mid-position. Mid-position is represented by the line X-X. Distances in the X direction give positions of the piston from the crank or back end.

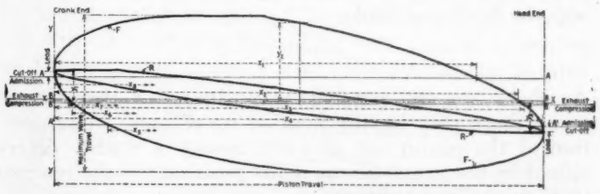


Fig. 1—Valve-ellipse diagram

The line A-A represents the position of the valve for admission and cut-off on the crank end. The line B-B represents the position of the valve for compression and exhaust on the crank end. The lines A'-A' and B'-B' represent corresponding events on the head end.

The graph F is an ellipse at full gear. When the piston is at the crank end, crank on back dead center, the valve is the distance y_1 from mid-position. When the piston moves half of its stroke to mid-position, the valve is the distance y_2 from its mid-position, having moved its maximum distance to the back and begun its movement forward. When the piston is the distance x_1 from the crank end, the valve has moved to the cut-off point and cut-off takes place. Exhaust takes place as the piston has moved the distance x_2 from the crank end. As the engine has exhaust clearance, or negative lap, exhaust will take place before the valve has reached the mid-position.

Further movement of the piston the distance x_3 from

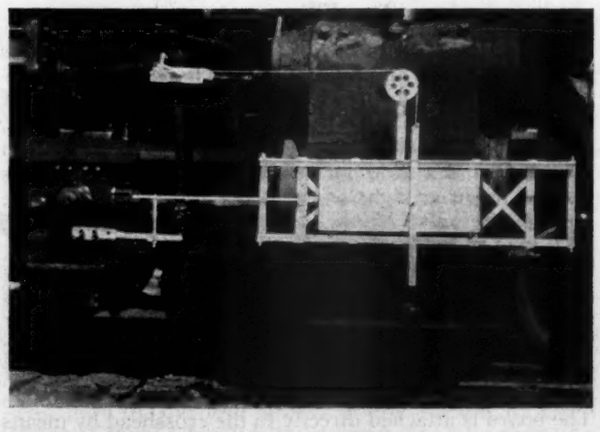


Fig. 2—Application of the ellipsometer to the right side locomotive

* Mr. Bohen, the author of this article, is a mechanical draftsman on the Florida East Coast, St. Augustine, Fla.

the crank end sees the valve cross the mid-position and move forward until the front exhaust ring is line and line with the front exhaust port so that compression begins on the head end of the cylinder. As we find the piston movement the distance x_4 from the crank end, the valve has moved forward until the front admission ring is line and line with the front admission port, the point of admission for the head end. As the piston moves to the front end of the stroke, crank on front dead center, the valve has moved forward from its mid-position the distance y_3.

On the back stroke a piston movement x_5 from the head end will give the cut-off, x_6 exhaust, x_7 crank-end compression, x_8 admission crank end, and the full stroke front to back completes a cycle. The ellipse R for the running cut-off may be followed in the same way. The value of p is found by subtracting the distance between rings from the distance between ports. We see then that the lead on the crank end

$$= y_1 - \frac{p}{2}$$

and the head-end lead

$$= y_2 - \frac{p}{2}$$

As there are any number of positions of the reverse lever, there may be any number of ellipses. The position of the piston for all valve events is readily determined by the graph for as many positions of the reverse lever as there are ellipses.

Most of the locomotive builders and manufacturers of valve gears have small models made of the valve gear to be designed, with adjustable parts which can be

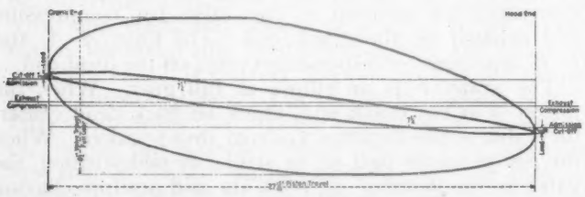


Fig. 3—Left side; forward motion on engine equipped with a Baker valve gear

made to conform to the dimensions of the parts intended to be used on the new locomotive. With this model, a study is made of the valve events. Most models are equipped with an attachment for recording the events. The valve movement is drawn to twice the scale of the piston movement.

The Ellipsometer

A machine for recording valve ellipse diagrams is commonly called an ellipsometer. The ellipsometer designed and built by the Florida East Coast consists of three essential parts: A frame which supports a track, a plane board which moves backward and forward on the track, and a slide bar holding a pencil which moves up and down at right angle to the track. This device records the valve ellipse, developed by the locomotive, on a card to full scale.

The frame supporting a track made of 1¼-in. by 1¼-in. by 3/16-in. T-iron, *A*, as shown in Fig. 2, is mounted rigidly to the side of the locomotive cylinder by means of plugs, which are applied in place of the cylinder indicator plugs. A white-pine board 12 in. by 33 in. by $\frac{1}{16}$ in., mounted on rollers, moves on the track. The board is attached directly to the crosshead by means of an arm and rod, as shown in Fig. 2, so that the exact movement of the crosshead is transferred to the board. A slide bar, holding a pencil, is mounted midway of the frame and at right angles to the track by means of the guides. The valve crosshead attachment is fastened firmly to the valve crosshead. A $\frac{1}{16}$-in. flexible wire cable is stretched over the sheave and attached to the upper end of the slide bar.

A 20-lb. weight is attached to the lower end of the slide bar to hold the cable taut. The movement of the valve is duplicated by the slide bar. If a piece of drawing paper, cut to the proper size, is secured to the board with thumb tacks, the pencil held in place by the spring in the pencil holder and the locomotive moved one revolution of the drivers, a graph will be drawn, the abscissa representing piston positions, and the ordinates valve positions for all points of the cycle. Such a graph is termed a "valve ellipse."

For the graph to be of value it is necessary to draw the cut-off and exhaust lines for both front and back ends. This is done before the graphs are made. A graph recording device is applied to both sides of the locomotive. The port marks are marked on a chalked surface on the valve crosshead attachment. The valve-port plugs are removed from the steam chest. The pin is removed from the eccentric rod and the valve moved until the cut-off position, determined by a thin feeler inserted through the port observation hole, is reached. The pencil is released for tracing, the bar is lifted from the crosshead arm and the board is moved across the track drawing a cut-off line.

The position of the valve is marked with a tram on the valve-crosshead attachment. The cut-off line for the other end of the cylinder and the two release or exhaust lines are drawn in the same way. The bar is placed back on the crosshead arm anad the port observation plugs replaced.

This procedure is repeated on the other side of the engine and the ellipses are ready for recording. The mid-position of the valve is found by drawing a line parallel to and equidistance from the two cut-off lines, as *X-X* in Fig. 1. The perpendicular distance between the two cut-off lines should equal the blue-print dimensions for the distance between ports, minus the distance between rings. Likewise between exhaust lines equals over the ports minus over the rings. Errors in the dimensions of the valve spool or the spacing of the valve bushings may be detected by checking these relations.

The "plane-board straight-line-movement" type ellipsometer in use on the Florida East Coast has certain advantages over the conventional "revolving cylinder" type. One of the outstanding advantages is in the fact that the card is on a flat surface, which enables the diagram to be observed during its development. A preliminary study of the condition of the valves can be made without removing the card from the board. This particular type of ellipsometer can readily be used to determine the proper position of the reverse lever for any desired cut-off.

Proper Time To Take Ellipse Diagrams

It is a difficult problem to set valves properly when an engine has just been overhauled on account of the various allowances that must be made. It is almost a practical impossibility to decide just what allowances to make for the expansion of those parts of the valve mechanism which are affected by heat under working conditions. Superheated steam passing through the steam chest will have an effect on the distance between ports. A newly overhauled engine will settle some after it has been in service for a time. In view of these facts it is best to make a final check on the valves after

the engine has been broken in and execute any necessary alterations that may be indicated by the diagram. When an engine is just in from her run and still hot is an ideal time to apply the ellipsometer and record diagrams of its valve events. Approximately an hour's time is required to apply the two recording devices and secure cards on both right and left sides, with two men working on the job. Hostler service is also required for about 10 or 15 minutes to move the engine after everything is in readiness.

Valve Events Recorded with Walschaert Valve Gear Taken on the Right Side in Forward Motion

	Per Cent Cut-Off		Pre-Admission, In.		Release, In.		Compression, In.		Cut-Off, In.	
Ellipse	Head	Crank	Head	Crank	Head	Crank	Head	Crank	Head	Crank
A (Full gear)	89	84	1/16	0	20 1/16	25 5/16	1 1/16	1/16	24½	23⅛
B	73	66	1/16	0	24 1/16	23	2 1/16	1 1/16	20 1/16	18¼
C	32½	27	¾	5/32	18 1/16	16 5/16	6⅞	5 1/16	9	7⅜

Settings Usually Taken

In the case of road engines two ellipses should be taken in forward motion, one of full gear and one of the running cut-off. Fig. 3 represents the final card of the left side of a 4-8-2 type passenger engine after the valves were adjusted.

The engine has 26-in. by 28-in. cylinders, 8½-in. valve travel, and 5/16-in. lead. The card shows that these conditions are fulfilled and the running cut-off within ¼ in. of equalization. Note the card illustrated in Fig. 4. In the "hooked-up" position the cut-off shows a difference of 4 in., 10⅝ in. on the head end and 6⅝ in. on the crank end. There is a lead of 9/32 in. on the head end and ⅛ in. on the crank end. If we should shorten the valve stem 5/32 in., the cut-off would be equalized 8⅞ in. on each end, but the difference in lead would be reversed. It was found in this case that the eccentric crank was set ½ in. less than the required radius.

Fig. 5 is a diagram showing four different positions of the reverse lever, with an accompanying table giving

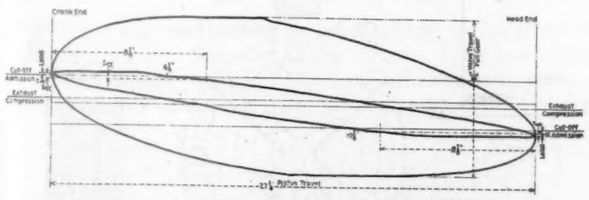


Fig. 4—Card taken on the left side in forward motion; Baker gear

the values of the different valve events. We see that there is a lead of 9/32 in. on the head end and 5/32 in. on the crank end. In the hooked-up position there is a cut-off of 9 in. on the head end and 7⅜ in. on the crank end. If the valve stem were shortened a scant 1/16 in., the cut-off would be equalized 8 7/16 in. on each end and the lead made 7/32 in. for both ends.

Marking the Quadrant

The ellipsometer proves useful in marking the quadrant so that the engineman can move the reverse lever to the required position to secure the desired running cut-off. With the device in place and the cut-off lines drawn on the card, the ellipse of full gear is taken and the engine stopped. This shows the piston stroke on the card. From both ends of the stroke the required distance, previously figured, to give the desired cut-off is measured and marked on the cut-off line. The locomotive is again put in motion and the pencil allowed to trace the valve movement on the card. The reverse lever is hopped-up until the pencil crosses the cut-off lines at the points marked for the desired cut-off. This position of the reverse lever is correct to secure the desired cut-off and the quadrant is so marked. This method was utilized to advantage in road test work, the quadrant being readily marked for full gear, 75, 50, 33, 25 and 20 per cent cut-off.

Precautions to Avoid Error

A diagram which is not true to actual conditions is far worse than none at all. To avoid getting an erroneous card the operator should be very careful in setting up the recording device. The cable should run parallel

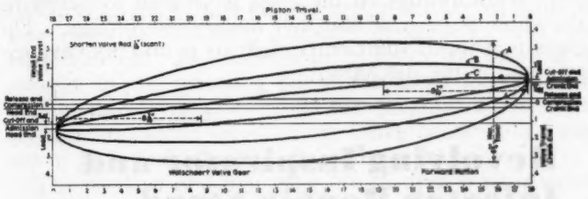


Fig. 5—Valve-ellipse diagram taken on the right side in forward motion; Walschaert valve gear

to the piston rod from the valve crosshead attachment to the sheave and perpendicular to the track from the sheave to the slide bar.

After recording devices are applied to both sides the engine should be hostled up and down a few times to make sure the cable is well stretched. Lost motion between the push bar and the board must be absent. The port marks should not be taken until the operator is satisfied the machines are functioning correctly. Extreme care should be exercised in taking port marks.

When taking ellipses the engine should be allowed to make two or three revolutions before the pencil is lowered to make sure the valve gear has settled down. The engine should be moved at a speed of about five miles an hour when cards are being recorded. It is well to take two cards of each side that one may serve as a check against the other.

Tool for Extracting The Sight-Feed Glass

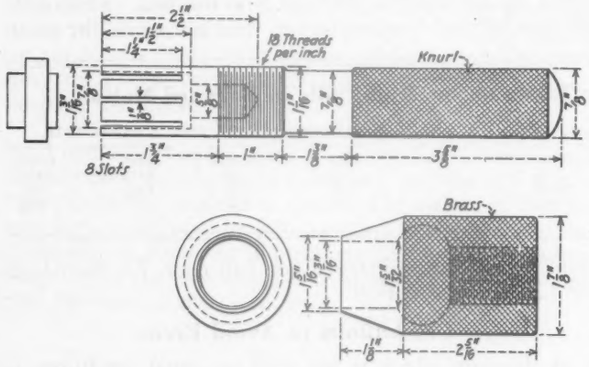
SHOWN in the drawing is a small tool for extracting the sight-feed glass in bullseye locomotive lubricators. Both parts are made of brass with knurled handles. The part of the tool shown at the top of the drawing is drilled ⅞ in. to a depth of 1½ in. and 5⅛ in. to an additional depth of 1 in. Eight ⅛-in. slots are cut in the drilled end to a depth of 1¼ in. It is threaded 1-1/16 in. for a distance of 1 in.

The part of the tool shown at the bottom of the drawing is tapped for 1-1/16-in. thread and is screwed on the part shown at the top.

To remove the sight-feed glass or bullseye the fol-

lower or sight-feed-glass rack ring and brass washer are removed. The gasket around the bullseye is then removed and the assembled tool is inserted in the opening.

The prongs formed by the eight slots cut in the end



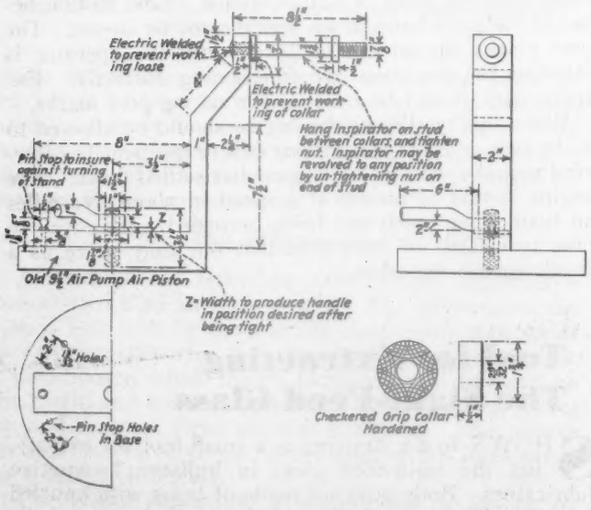
Small tool for extracting lubricator bullseyes

of the tool engage the small end of the glass. A tight grip of the prongs on the glass is secured by screwing the outer portion of the tool toward the prongs. The glass is gripped sufficiently tight to permit its easy extraction by the mechanic.

Revolving Inspirator and Injector Repair Stand

By E. G. Jones

IN quite a few shops the present method of holding an inspirator or injector while repairing is in a bench vise. Often times the body of an injector is crushed by the vise being too tight. In applying the tubes, nozzles and grinding valves, the vise must be released and the injector moved to many different positions, which consumes time.


Electric Welded to prevent working loose
Electric Welded to prevent working of collar
Hang Inspirator on stud between collars, and tighten nut. Inspirator may be revolved to any position by un-tightening nut on end of stud
Pin Stop to insure against turning of stand
Old 9½" Air Pump Air Piston
Z=Width to produce handle in position desired after being tight
Holes
Pin Stop Holes in Base
Checkered Grip Collar Hardened

Revolving stand for repairing inspirators and injectors

By using the work stand shown in the drawing, there is no possible chance to damage the body of the injector and any desired position may be easily obtained by revolving the stand and the injector body.

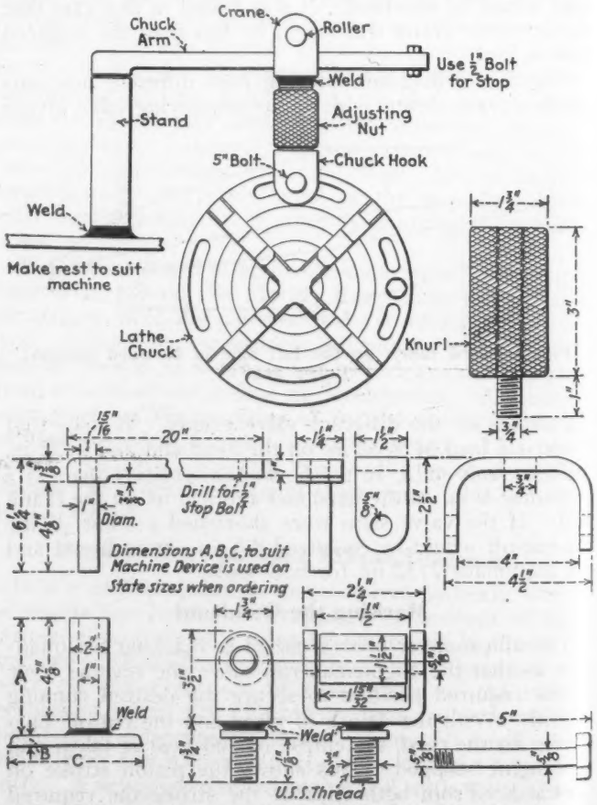
This work stand is made of a scrap 9½-in. air piston as a base and tapped for the pivot stud. Small holes are drilled in the base which are used as pin stops to insure against turning. The pivot-stud clamp nut has a handle welded to it which eliminates the use of a wrench when it is clamped or unclamped. The stand column is made of 1-in. by 2-in. flat iron, bent, tapped and drilled as shown. The horizontal or hanging stud is screwed into the column and welded on the back to prevent it from working out. Two checkered and hardened grip collars are applied to the hanging stud to prevent the injector from turning while being repaired.

By means of this repair stand the injector can be revolved to any desired position without loss of time.

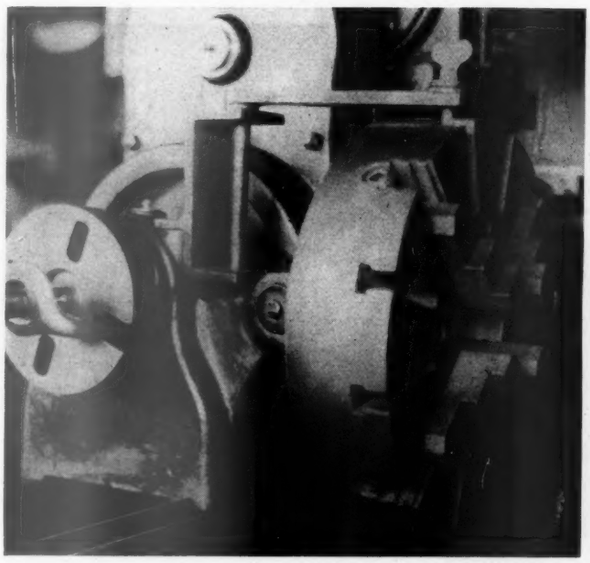
A Swinging Support For Heavy Chucks

IN places where a variety of work must be done on a single lathe, usually requiring a small and large chuck alternately, means for applying the larger chuck is a great convenience. In the illustration and drawing are shown two methods adopting the same principle whereby a swinging arm fastened to the headstock of the lathe supports the heavy chuck. This arrangement greatly facilitates the handling of the chuck and eliminates the need for extra help or the use of a crane.

The swinging support shown in the illustration is located in the electrical shops of the Louisville & Nashville, at Louisville, Ky. It is made of brackets bolted directly to the lathe and fitted with a vertical shaft and arm from the latter of which the chuck is supported by means of a bolt fitted with a wing nut. The device is arranged with a hollow stand which is welded to the



Another type of swinging support for applying heavy chucks



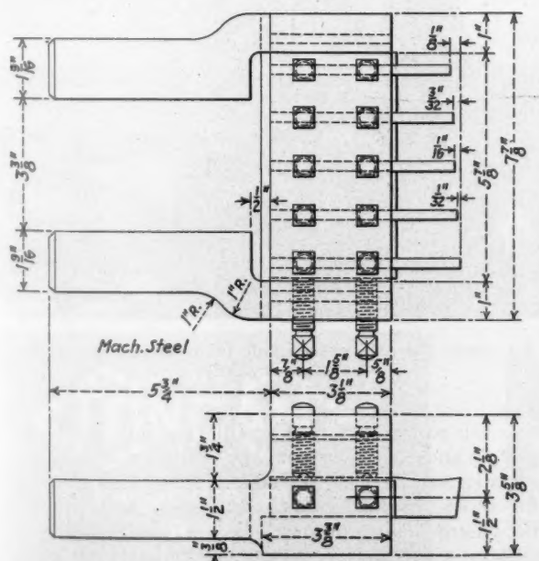
A swinging support provides a convenient means for applying the heavy chuck

headstock of the lathe. The arm which supports the chuck is fitted at one end with a pin 4⅞ in. long turned to a diameter of 1 in. for a snug fit in the stand. The chuck is suspended from this arm by means of a chuck hook which is attached to a pulley by means of an adjusting nut. The pulley permits the chuck to travel the length of the chuck arm, facilitating the placing of the chuck for threading onto the spindle. Vertical adjustment of the chuck can be made by means of the adjusting nut.

Gang Tool for Cutting Piston Packing Rings

THE gang tool shown in the drawing is designed for cutting off piston packing rings. It is comprised of a rectangular shaped body with an extension piece at each end for attaching it to the tool post on the sliding head of the boring mill. Filler blocks are used between the tools so that the distance between the cutting edge is the width of the piston packing rings. The dimensions of the filler blocks will depend on the standard widths of rings used. After the filler blocks and tools are inserted in the body of the holder they are clamped longitudinally by two set screws placed 1⅝ in. apart. The tools are held vertically by ten set screws, two for each cutting tool.

The tool holder is made of machine steel and is 5¾ in. wide, 7-⅞ in. overall in length and 3-⅝ in. high, to the top of the set screws. The usual practice of receding the successive tools is followed, the cutting edge of each tool being set 1/32 in. behind the preceding one.



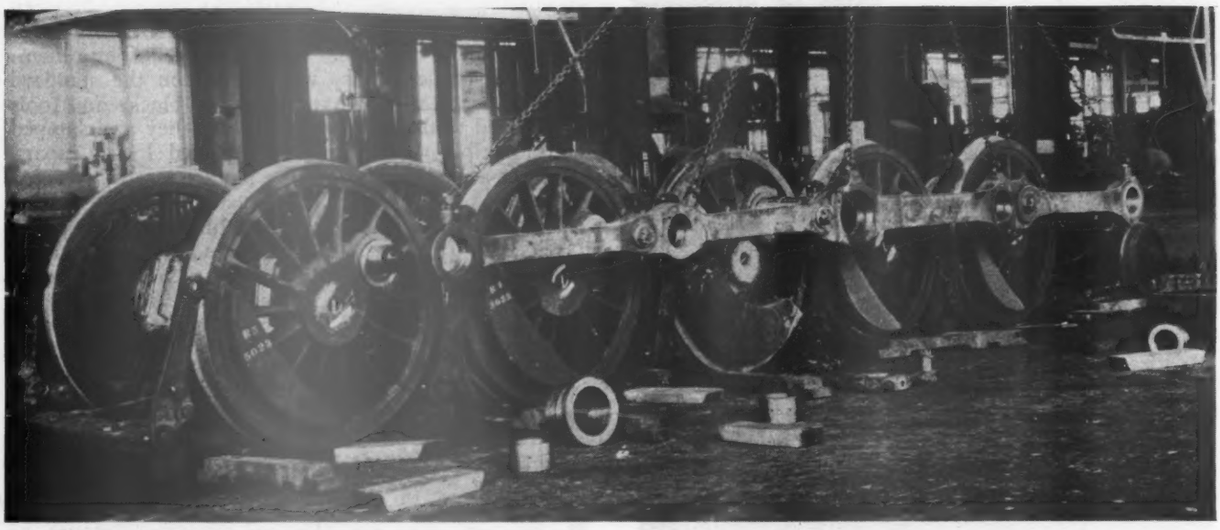
A gang tool for cutting off piston packing rings

Wheeling Locomotives

THE wheeling of locomotives is an operation which in itself does not take an excessive amount of time provided suitable advance preparation has been made and the work properly organized. Much study has been given to this subject and a number of more or less effective wheeling methods developed. The one shown in the two illustrations includes the location of wheels on the wheeling pit in the usual manner with driving boxes in place with the pedestal binders and wedges supported on blocking, brake beams and hangers in place and all side rods on the crank pins.

The method of supporting the binders is of interest, consisting of blocks or permanent jacks mounted on short longitudinal channel irons, which in turn are supported on scrap rails extending across the pit. After the wheeling operation, simply spreading the rails permits the channels with blocks or permanent jacks to drop into the pit. The rods on each side of the locomotive are moved as a unit by means of the shop crane from the rod job and applied to the wheels. With accurate tramming of the rods as well as careful lining of the shoes and wedges, all parts fit together accurately and the wheeling of the locomotive proceeds without difficulty or delay. The locomotive is lowered carefully by the shop crane until the binders are in place, the binder nuts then being applied without difficulty. Brake

End view of wheels, binders, wedges, brake rigging and trailer truck assembled ready for wheeling



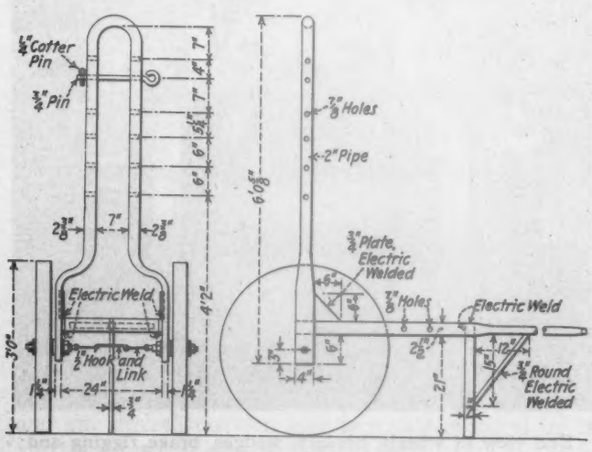
Labor-saving method of applying side rods to 2-10-2 type locomotive—The chains are all suspended from the crane hook

hangers, beams and rods, having been previously assembled in place are applied by the simple process of inserting brake-hangar pins and cotters. The side rods are already on and the locomotive is therefore ready to be lifted to the center track or pulled out of the shop as soon as the blocking is dropped. The second illustration gives an end view of the wheeling arrangement just before the locomotive is lowered onto its wheels.

It is estimated that this method of wheeling locomotives saves approximately 45 man-hours in rod handling, 20 man-hours in brake-rigging application, and 20 man-hours in the wheeling operation itself. While a little longer is taken in getting ready for the actual wheeling operation, the locomotive, once wheeled, requires little more work to make it ready to leave the shop and be conditioned for the trial runs.

Handy Tire Wagon For the Back Shop

THE tire wagon shown in the drawing can be used for handling tires of all sizes. The frame is of forged wrought steel and electrically welded. The wheels are of cast iron.



Wagon for handling tires of various sizes

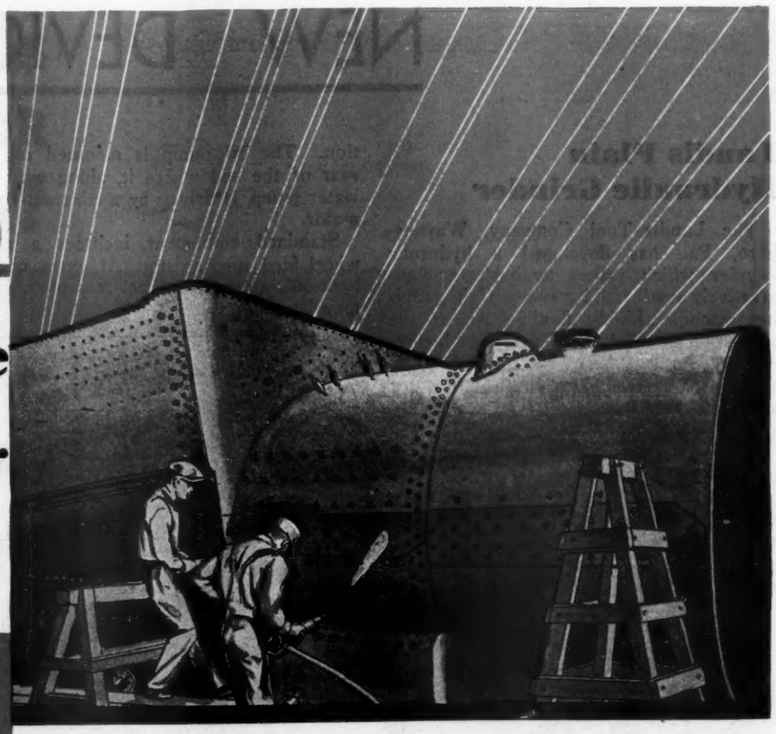
A ¾-in. pin is used to support and hold the tire in position. To prevent interference with the axle, but at the same time give the cart the necessary rigidity, a ½-in. hook and link is used to attach the two wheel-journal connections. It is unhooked when loading and hooked after the tire is in place.

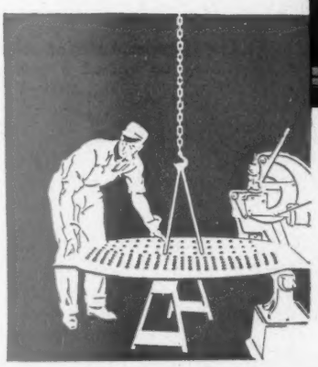
An Air Clamp For the Drill Press

PNEUMATIC clamps for drill presses are not new, as compressed-air power is frequently used to clamp the tools in a wheel lathe, and to clamp down the tail stock of the same machine. The illustration shows a shop-made drill-press clamp which utilizes an old locomotive ash-pan cylinder. The fulcrum hole in the lever is slotted and the lever may be swung about to serve practically any part of the table. This press is used on brake shoes, brake beams, equalizers, and other flat work where many duplicate parts are handled, frequently on a production or piece-work basis for stock or shipment to outlying points.

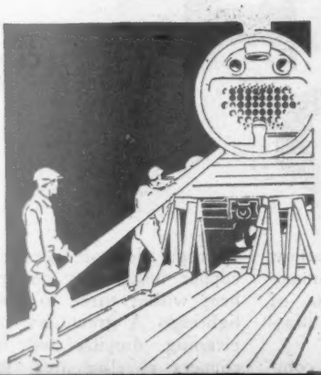
Air clamp for drill press made from an old locomotive ash-pan cylinder

Build low maintenance into your boiler





AGATHON NICKEL IRON



● WHAT goes into the boiler today will determine the repair costs a few years hence.

Just as modern design has improved locomotive operation, so, too, modern metallurgy has improved boiler maintenance.

Modern boiler tubes of Toncan Iron, due to their superior resistance to corrosion and their uniform, seamless quality far outlast the old tubes.

Modern staybolts of Agathon Nickel Iron have the increased tensile strength required by present day boiler pressures. They are doubling the mileage per staybolt renewal for progressive railroads.

Firebox sheets of Toncan Iron resist corrosion and fire-cracking. This alloy of refined iron, copper and molybdenum has substantially extended the life of side sheets.

In these and many other instances, Republic metallurgists have developed special alloy irons and steels that are improving locomotive performance and lowering maintenance.

REG U.S. PAT. OFF.
TONCAN
COPPER
Mo-lyb-den-um
IRON

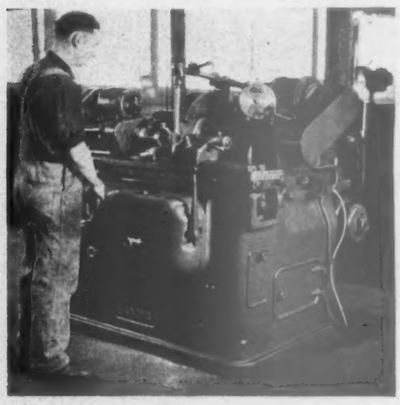
REPUBLIC STEEL CORPORATION
GENERAL OFFICES: YOUNGSTOWN, OHIO

NEW DEVICES

Landis Plain Hydraulic Grinder

The Landis Tool Company, Waynesboro, Pa., has developed a hydraulic grinder which makes available a comparatively small rapid traverse plain grinding machine, highly flexible but at the same time ideal for the mass production of light parts. It is recommended for such work as small bearings, small motor armatures, light shafts and all work of a similar nature.

The outstanding feature of the machine is its productiveness coupled with ease of operation. Such ease of operation is achieved by smoothness of all machine movements and by a skillful grouping of the controls. Hydraulic table traverse gives a range of table speeds from 6 in.



Landis hydraulic grinder for the rapid production of small parts

to 240 in. per minute. Accessibility to the various mechanisms is another desirable feature. By removing the large cover at the front of the bed all control mechanisms are exposed. None of them is entirely within the bed. The design of the complete pump mounting is such as to make it quite accessible.

The bed is of box-type construction. The water reservoir is integral with it while its base forms a reservoir for the oil used by the hydraulic traversing system. The work carriage traverses on a flat guide and a V-guide with one vertical side; both guides having chilled surfaces. Guide-way lubrication is of the flood-type, filtered oil being used and being supplied by the same oil pump which furnishes pressure for the hydraulic system. Provision is made for the tarrying of the work carriage at reversing points.

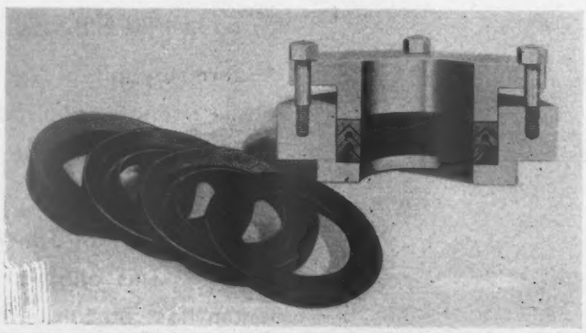
The hydraulic system consists of a twin-cylinder-type table-traversing mechanism and a Tuthill internally geared oil pump. Because of the use of twin cylinders, the control valve is made to govern the flow of oil from the end of one cylinder into the corresponding end of the other, thus giving an unusual smoothness of operation. The oil pump is mounted on the rear of the bed where it, along with the water pump, is driven by a constant-speed motor.

Standard equipment includes a plain wheel-feed mechanism. At extra cost a hydraulic automatic wheel-feed mechanism may be supplied or, for certain high production jobs, a hydraulic straight infeed mechanism is also available. The headstock is driven by a constant-speed motor. Four work speeds are made possible by changing the pulley and the belts at the left-hand end of the head.

This machine is available in a 6-in. by 18-in. size which weighs 3,750 lb. net, without electrical equipment and also in a 6-in. by 30-in. size which weighs 4,000 lb. net, without electrical equipment. Constant-speed motors are used throughout; a ⅓-hp. for the headstock, a 1-hp. for the pump drive and a 3-hp. for the wheel-spindle drive.

Garlock Chevron Packing

The Garlock Packing Company, Palmyra, N. Y. recently brought out a packing which, because of its peculiar construction, is designated as Chevron-430 packing. It is designed for use on rams and plungers of accumulators, presses, pumps and other heavy-duty hydraulic equipment. It is referred to as an automatic packing, its design permitting the use of a plurality of rings in shallow stuffing boxes which will not accommodate a suitable number of rings of ordinary packing. This feature is illustrated.



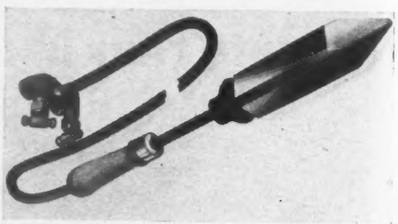
The Garlock 430 Chevron packing (Patented)

For a high temperature service this company is manufacturing a packing which is of the same type and design as the Garlock-430 Chevron packing, but which is constructed of heat resisting materials. This is designated as the Garlock-530 Chevron packing. Both types can be made to specifications for all sizes of stuffing boxes, each set of packing being provided with top and bottom adapter rings conforming respectively to the level of the gland and the stuffing box.

Gas-Heated Soldering Iron

Increased efficiency and greater economy are two of the outstanding advantages of the new "Torchiron" gas-heated soldering iron recently introduced by the Reliance Specialties Manufacturing Company, 122 East Forty-Second street, New York.

Using the "Torchiron," the operator has a continuously heated soldering iron



The temperature of this soldering iron may be varied by regulating needle valves

for steady work. With the 3-lb. head, the fuel required is only 4 or 5 cu. ft. of gas per hour, and with the 5-lb. head, 5 or 6 cu. ft. of gas per hour. This iron is heated by either natural or artificial gas and low-pressure air mixed by means of a needle valve, and passing through a flexible hose to the handle of the torch, making it easy to operate.

Constant temperatures are increased or decreased at the option of the operator by regulation of the needle valve. The copper heads may be brought to a red heat within three to five minutes after lighting. A great deal of the filing and cleaning, dipping and retinning of the coppers is eliminated, inasmuch as the copper heads are not exposed to the open flame.

Coppers are available in sizes ranging from ½ to 5 lb. They also are made to specifications. The coppers are quickly interchangeable, being screwed on to the stainless-steel tip. As the name implies, the "Torchiron" may be used as a torch as well as an iron, merely by removing the copper head.

(*Continued on next left-hand page*)

Pounds OR Performance?

● *SUPER-POWER LOCOMOTIVES ON THE BOSTON AND MAINE*

THERE was a time when weight and traction was everything in a locomotive. If a train could be started, if it could get over the worst grades, the locomotive did all that was required.

In present-day railroading there is no room for such "slow drags". Locomotive performance, measured in gross ton miles per hour, is the governing factor.

The demand now is for maximum power per pound of metal and per pound of fuel burned.

Super-Power Locomotives justify their purchase on this basis. Their increased earning power is making remarkable economies on many leading railroads.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS • Incorporated • LIMA • OHIO

Diamond U-Type Hydraulic Packing

The Diamond Rubber Company, Akron, Ohio, has developed a new product, known as "Rubber Crimps," or U-type hydraulic packing, for service on hydraulic rams and presses. The new packing is made in rings of standard sizes, with a U-shape cross section. The rubber is especially compounded to resist oil and is covered almost completely with a layer of fabric which adds considerable strength and helps to maintain the ¼-in. flare at the bottom.

The following advantages are claimed for this packing: Low cost; suitable for use with pressures up to 3,000 lb. and more; not affected by the heat generated in a hydraulic press; wears slowly and evenly; it fits snugly against the ram at all times, making a tight seal, even when the ram is imperfect; thickness vertically through center is ¾ in., which serves to stiffen the flare and increase the strength and life of the packing and it will not dry up when a press is idle.

Trackson Industrial Tractor Crane

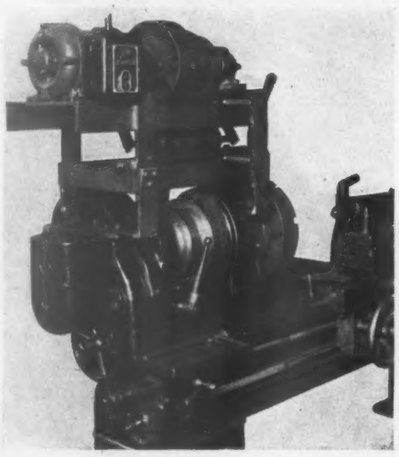
The Trackson Company, 500 Clinton street, Milwaukee, Wis., has developed an industrial crane mounted on a McCormick-Deering tractor for use in and around shops and yards. The unit is designed to speed up such jobs as lifting, spotting cars, carrying car parts, sills, wheels, rails or other heavy or unwieldy weights. This improved Trackson crane has a new hoisting mechanism controlled by a single lever which operates both the clutch and the brake, giving the operator complete control of the crane and its load at all times. When the lever is pulled back the boom raises. In the neutral position the clutch is disengaged and the brake is applied. A slight forward pressure on the same lever releases the brake and allows the boom to lower. The entire operation of the tractor and crane may be performed by one man.

A Trackson crane handling locomotive wheel centers

Motorized Unit For Machine Tools

The Production Equipment Company, Cleveland, Ohio, has recently developed a motorized unit drive for machine tools which makes it economically possible to change belt-driven machines to motor drive. This is accomplished by the application of a specially designed unit-type drive which performs the functions of line shaft and countershaft.

The complete motorized unit consists of the base and the drive unit. Two styles



A motorized unit with box-type base and idler pulley applied to a lathe

of bases are regularly used—the box type and the overhung type—depending upon the type of machine tool to which the application is made. The box-type base provides support at all bearing points and assures accurate alinement under all operating conditions. It permits the ready mounting of an idler pulley and belt shifter, thus giving a complete unit which will meet practically any engineering or safety requirement. The box-type base is usually supplied with two U-shaped supporting members which are mounted directly over the spindle-bearing caps. The belt is entirely inside the box construction and, to comply with the safety codes, a mechanical belt shifter can be built in and wire mesh covers furnished for the box. The box-type mounting also permits the use of an idler pulley which makes possible heavier cuts than can be made when a machine is driven from a line shaft.

The overhung type of drive utilizes a base mounting on a welded steel base supported from a structural-steel column which is bolted to the side or rear of the machine. The countershaft base is hinged at the upper end of the column and the belt tension is adjusted by means of a simple cam operated by an adjusting lever. The overhung type of base is usually used without the mechanical belt shifter or the idler pulley, although these auxiliaries may be used if desired.

The drive unit consists of a speed reducer with an extended shaft to which the drive pulley is keyed. The shaft has an outboard bearing. The speed of the extended shaft is designed to duplicate the normal speed of a countershaft. The unit is supplied in ratings from ½ to 20 hp. in single- or multi-speed designs, reversible if desired. This type of drive may be used with either single-pulley or cone-type machines. The electrical equipment is fitted with push-button control.

Brown & Sharpe Small Tools

The Brown & Sharpe Manufacturing Company, Providence, R. I., has recently announced some new cutter adapters,

One of the cutter adapters for use with the standard milling-machine spindle

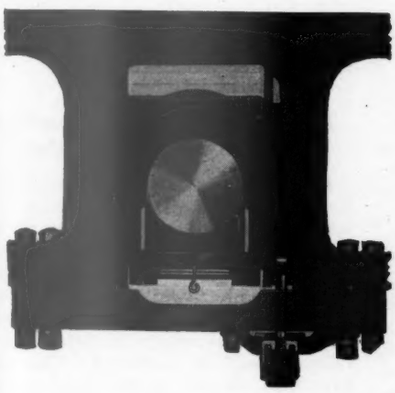
spiral two-lipped end-mills, arbors for shell end-mills and screw arbors for use with these adapters, which have some unusual features of design.

The adapters are furnished in two different styles for use with milling machines having the standardized spindle end and, also, in one style for use on milling machines having taper or threaded-nose spindle. The adapters are furnished with a milling-machine standard taper hole into which the shank of the end mill or arbor fits.

The end mill or arbor is held securely to its seat by a cam furnishing a positive drive. The surface of the cam engages the flat surface of the groove in the shank of the cutter. When the cam is turned to release it, the cutter or arbor drops from the adapter, the steep taper preventing sticking and insuring quick release. These adapters, arbors and end mills are furnished in a desirable range of sizes.

(Continued on next left hand page)

No HAND ADJUSTMENT *can do* THIS JOB . . .



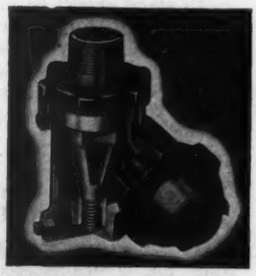
■ THE FRANKLIN AUTOMATIC ADJUSTABLE WEDGE

Set-up an ordinary driving box wedge in the roundhouse as tight as you dare, and even then you must allow a little play to prevent a stuck box. That play soon grows to a clanking pound and shortly the brasses run hot or need attention.

But Franklin Automatic Adjustable Wedges eliminate all slack. They adjust themselves automatically with every revolution of the drivers. Slack has no opportunity to develop and cause trouble.

Franklin Automatic Adjustable Driving Box Wedges keep brasses from pounding their way into the shop. Use them to lower maintenance and keep modern power in service.

THE FRANKLIN SLEEVE JOINT
A reliable conduit, free from limitations in movement, permitting short vertical pipes and greater rail clearance.



FRANKLIN RAILWAY SUPPLY CO., INC.

NEW YORK CHICAGO SAN FRANCISCO ST. LOUIS MONTREAL

NEWS

More Air-Conditioned Equipment on the B. & O.

IN ORDER TO MEET the popular demand for air-cooled cars, the Baltimore & Ohio has added air-conditioning equipment to two more of its trains between Washington, D. C., and New York, one leaving Washington daily at 9:10 a. m., and the other leaving New York (Jersey City) at 9:30 a. m. Beginning Monday, July 20, trains No. 6 and 523 will be equipped with the air-conditioned cars, consisting of smoking-lounge car, latest type parlor cars, individual seat coaches and colonial dining car.

The first air-conditioned train, which started on May 24, was the "Columbian," between Washington and New York.

Court Sanctions L. & N. Shop Closing

THE FEDERAL DISTRICT COURT at Louisville, Ky., on July 6, issued a temporary injunction restraining the city of Cloverport (Ky.) from attempting to compel the Louisville & Nashville to fulfill a contract which provides for the maintenance of shop facilities at that point. The court held that the city is entitled to a jury trial to determine the amount of damages, not in excess of $20,000, to which it may be entitled. The contract with the city was originally made by the Louisville, St. Louis & Texas, and provided that the road's shops should be located at Cloverport in return for the proceeds from the sale of $20,000 city bonds. When the L. & N. purchased the Louisville, Henderson & St. Louis, the successor of the L., St. L. & T., the shops at Cloverport were abandoned.

Rock Island to Convert Locomotives for Oil Burning

THE CHICAGO, ROCK ISLAND & PACIFIC plans the immediate conversion of 231 additional locomotives used on its lines south and west of Kansas City, Mo., from coal burning to oil burning. The conversion will involve the construction of 13 roadside stations for fuel oil on the lines between Kansas City and Belleville, Kan., and between Herington, Kan., and El Reno, Okla., including a number of branch lines in Oklahoma.

Oil stations will be located at Topeka, Kan., Cline, Caldwell, Clay Center, McFarland, Armourdale, and Herington; Haileyville, Okla., Hobart, Lawton, Enid, Ardmore, and Anadarko. The work of converting the engines will be done in the Rock Island shops and the working time there will be increased beginning July 13. It is expected that it will require from 60 to 90 days to complete the conversion.

When completed, this conversion will effect decided economies in operation on the basis of present fuel oil prices. Locomotives on the Arkansas-Louisiana and the Oklahoma divisions of the Rock Island were changed from coal to oil burning in 1930 and on the El Paso-Amarillo and Pan-Handle Indian Territory divisions in 1928.

Salary Reductions

The Canadian National on August 1 reduced all salaries of over $3,600 by 10 per cent for a period of ten months. The reduction applies to employees whose rates of pay are governed by scheduled agreements. Sir Henry Thornton, chairman and president of the Canadian National, said in Montreal that the reduction, despite his contract with the government definitely fixing his compensation, nevertheless included himself, and also all the higher officers of the system.

The Delaware & Hudson has made a reduction of 10 per cent in the salaries of officers, so far as approved by the president, in all positions where the salaries are equal to or greater than those paid to division superintendents or officers of corresponding rank.

A report of reduction in salaries of officers by the Southern Railway has been published in Washington, D. C., but the only statement authorized by the road is that there has been a voluntary reduction of salaries by officers which was not intended to be made public.

Wage adjustments affecting officers and clerical forces of the Missouri Pacific were made effective August 1 and employees will now work and receive pay for five days a week instead of five and one-half, as at present. Officers and unorganized workers will continue to work 5½ days and will receive weekly reductions equal to one day's pay. The adjustment does not apply to employees in train service.

Power Reverse Gear Hearings Adjourned to September

Hearings before Special Examiner J. L. Rogers of the Interstate Commerce Commission on the complaint filed by the two enginemen's brotherhoods asking the commission to require that all locomotives be equipped with power reverse gear have been adjourned until September 28, when the rebuttal testimony on behalf of the railroads will be continued. The roads have thus far put on the stand 118 witnesses, of which approximately one hundred were locomotive enginemen who disagreed with the witnesses presented on behalf of the brotherhoods and took the position that in the present stage of development the power reverse gear is not sufficiently safe and efficient to warrant its application to all locomotives.

(Continued on fourth left-hand page)

Domestic Orders Reported During July, 1931

Locomotives

Name of Company	No. Ordered	Type	Builder
Bangor & Aroostook	2	Switching	American Locomotive Company
Chicago, Burlington & Quincy	1	Switching	Whitcomb Locomotive Company
Total for month of July	3		

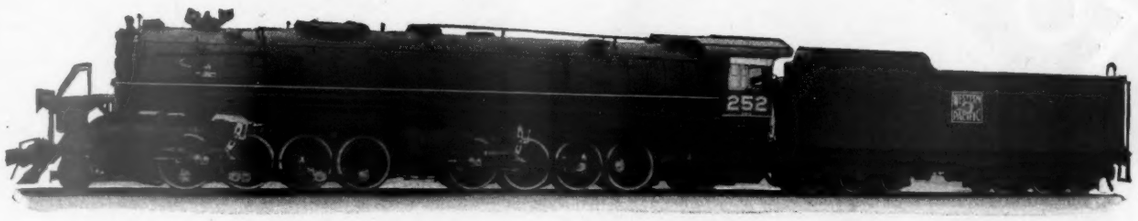
Freight Cars

Name of Company	No. Ordered	Type	Builder
Tennessee Coal, Iron & Railroad Company	4	Flat	Pullman Car & Mfg. Corp.
	4	Sheet, bar and steel-transfer	
Chicago & Illinois Midland	4	Caboose	Pullman Car & Mfg. Corp.
Navy Department of U. S. Government	6	Tank (helium)	General American Tank Car Corp.
American Railroad of Porto Rico	200	Sugar-cane	Gregg Company
L. C. L. Corporation	225	Container	American Car & Foundry Company
Total for Month of July	443		

For Fast Freight Service

on the

Western Pacific



2-8-8-2 TYPE LOCOMOTIVE
WESTERN PACIFIC RAILROAD

Cylinders (4)	26" x 32"
Drivers, diameter	63"
Steam pressure	235 lb.
Grate area	145 sq. ft.
Water heating surface	6880 sq. ft.
Superheating surface	2152 sq. ft.
Weight on drivers	552,700 lb.
Weight, total engine	665,100 lb.
Tractive force, main cylinders	137,000 lb.
Tractive force, with booster	150,900 lb.

THE WESTERN PACIFIC handles a large tonnage of freight, particularly fruits and vegetables, which moves on fast schedules.

To maintain the speed and to permit the handling of trains without helpers, this Railroad is placing in service six single-expansion oil burning Mallet locomotives of the 2-8-8-2 type built by The Baldwin Locomotive Works.

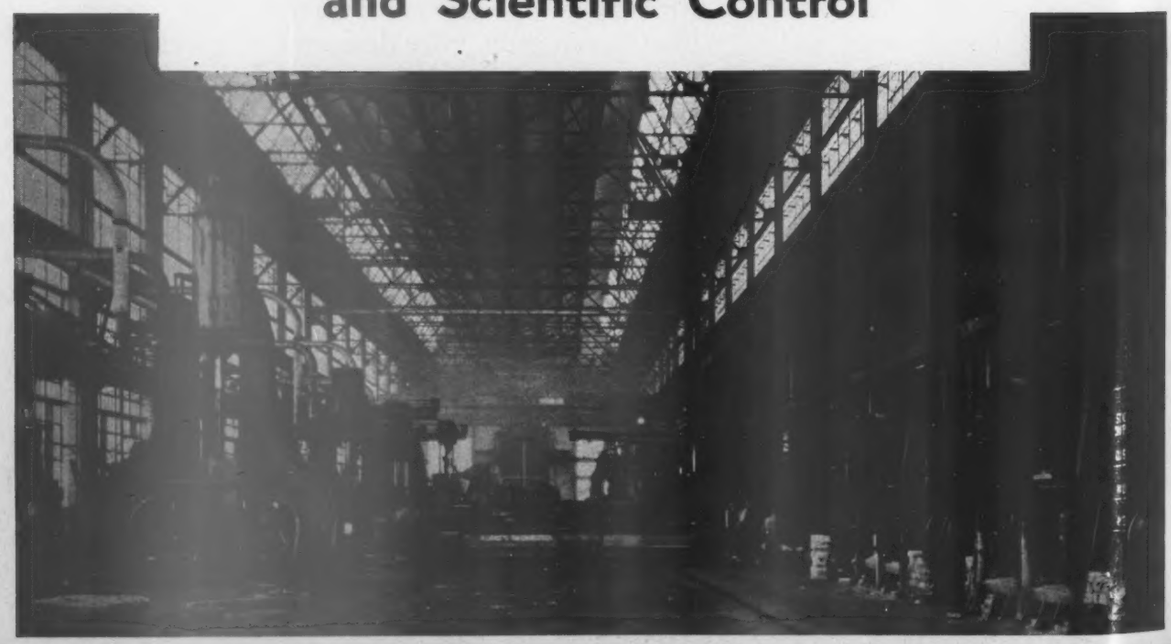
These are high-power locomotives capable of hauling greater tonnage, at a sustained high speed, than locomotives now in use. They were especially designed to meet operating problems on the line of the Western Pacific in the Feather River Canyon of the Sierra Nevada Mountains.

These locomotives are among the most notable of this type recently built.

THE BALDWIN LOCOMOTIVE WORKS 1831 1931

THE
BALDWIN
LOCOMOTIVE WORKS
PHILADELPHIA

Indicating and Recording Pyrometers Assure Complete and Scientific Control



ALCO FORGINGS

QUALITY billets are the sound foundation of all Alco quality forgings. But that is only the start. Heat treating before forging is of vital importance. That is why Alco exercises particular care and supervision to this phase in the manufacture of all Alco Forgings.

Proper heat treating is important because steel should not be charged into a hot furnace, as this often causes internal ruptures. This is especially true for the alloys and the higher carbon steels and even for medium steels in cold weather.

To avoid damage to the billets and to insure complete control over the heating of the steel before forging, six regenerative furnaces have been installed in the Alco Plant. In normal operation there are two cool furnaces ready for charging, two hot furnaces containing steel ready for the press and hammer, and the remaining two cooling off. These furnaces are oil-fired —the flame at no time comes in direct contact with the charge in the furnace—and all the furnaces are equipped with indicating and recording pyrometers.

This equipment furnishes a continuous and complete record of the forging during heating and enables us to know the rate at which the heat was applied, the time of soaking at heat to insure proper penetration, and that the proper temperature had been reached before withdrawing for forging.

The scientific execution of even the smallest detail in the heat treating process assures high quality forgings of great strength, uniformity, toughness and durability.

Alco Quality Forgings make good locomotives better—they multiply the utility and economy of your motive power both old and new.

Specify Alco Forgings — you get quality all ways always, from billet to finished forging.

American Locomotive Company

30 Church Street New York N.Y.

Supply Trade Notes

H. W. KELSEY, general sales manager of the Russell Manufacturing Company, Middletown, Conn., has been promoted to take charge of all purchases of his company.

ELLSWORTH L. MILLS, formerly sales manager of the Bastian-Blessing Company, Chicago, makers of welding equipment, has been elected vice-president. Mr. Mills continues in charge of sales.

GEORGE KIRTLEY has been appointed general sales manager of the H. K. Porter Company, with headquarters at Pittsburgh, Pa., to succeed Harvey Lefevre, who has resigned to go into other business.

C. N. JOHNS has been appointed general manager of the Page Steel & Wire Company, with headquarters at Monessen, Pa., and W. H. Bleecker, Jr., has been appointed sales manager, with headquarters at 701 American Bank building, Pittsburgh.

GEORGE D. BASSETT, vice-president of Crerar, Adams & Co., Chicago, has resigned to become manager of the railroad department of the H. Channon Company, Chicago, J. L. Taylor, vice-president in charge of railroad sales, having been assigned to other duties. Mr. Bassett was born in Batavia, Ill., on May 17, 1863. He entered railway service as a clerk in the store department of the Chicago & North Western and on June 16, 1879, entered the employ of Crerar, Adams & Company as an office boy. In 1898, he was promoted to salesman and in 1924, to vice-president.

George D. Bassett

CHARLES D. MACGILLIVRAY, assistant secretary of the Baldwin Locomotive Works, has been elected secretary to succeed Arthur L. Church, deceased, and J. Harrison Kerst has been elected assistant secretary, both with headquarters at Eddystone, Pa. Mr. MacGillivray and Mr. Kerst were also elected to similar positions with two Baldwin subsidiary companies, the Standard Steel Works Company and the Baldwin-Southwark Corporation.

L. F. WILSON, who has been elected president of the Wilson Engineering Corporation, Chicago, a company organized to manufacture, engineer and market the mechanical equipment and devices heretofore handled by the Bird-Archer Company, was born at Rush Lake, Wis., on November 4, 1883, and received his education at Ripon College, Lawrence University and the University of Wisconsin. He entered the railroad field as a telegraph operator and locomotive fireman on the Chicago, Milwaukee, St. Paul & Pacific. From 1906 to 1909 he was in the engineering department of the Western Electric Company, and from the latter date until 1911 was assistant editor of the Railway Review (now combined with the Railway Age) and for the following three years was editor of the Railway Master Mechanic (now combined with the *Railway Mechanical Engineer*). In 1914 he was appointed district manager of the Bird-Archer Company, which position he held until 1919. During the year 1917-18 he was also captain in the Quartermaster Corps of the U. S. Army, and from 1918 to 1926 was a major in the engineering division. In 1926 he was appointed lieutenant-commander of the U. S. Naval Reserve. From 1919 to 1928 he was vice-president and general manager of the Bird-Archer Company, and in the latter year he was elected president and general manager, which position he has held until his recent appointment.

L. F. Wilson

V. E. McCoy

V. E. McCoy, who has been appointed treasurer and mechanical engineer of the Wilson Engineering Corporation, was born on December 17, 1900, at Lincoln, Neb., and graduated from Montana State College in 1925. He entered the service of the Chicago, Milwaukee, St. Paul & Pacific as special apprentice in July, 1925, and served as combustion engineer from 1928 to 1929. In January, 1930, he was appointed assistant to the president of the Bird-Archer Company, which position he held until his recent appointment.

THE WESTINGHOUSE AIR BRAKE COMPANY has announced that Professor S. W. Dudley, Strathcona Professor of Mechanical Engineering and chairman of the Department of Mechanical Engineering in Yale University, has rejoined its engineering organization in an advisory capacity with the title of assistant to the vice-president, while retaining his university connections. After completion of his college course in mechanical engineering at Yale University and a short period of service on the faculty, Professor Dudley entered the employ of the Westinghouse Air Brake Company as a special apprentice in 1905 and advanced steadily until he was appointed chief engineer in 1914, which position he retained until 1921 when he accepted the chair of mechanical engineering in his Alma Mater. Many outstanding air brake developments mark the period during which he was associated with this company, and in these achievements he had a prominent part. Because of his broad experience, pleasing personality, and keen insight into human affairs as well as engineering practices, Professor Dudley has been in demand for various activities and positions of responsibility with the college. He is a member of the board of trustees and governing board of Sheffield Scientific School, chairman of the University Committee on Transportation, member of the Industrial Committee of the Institute of Human Relations in Yale, and member of

S. W. Dudley

(Continued on next left-hand page)

CARNEGIE MEANS SPEED WITH SAFETY

WHEELS are the focal point of safe transportation. Efficient signal systems, necessary as they are, cannot offset inadequate materials in rolling stock. Upon wheels must rest a major share of responsibility.

Carnegie Wrought Steel Wheels have earned an enviable reputation for the efficient manner in which they have shouldered this responsibility for many important railroad systems. To serve even more efficiently, Carnegie Rim-Toughened Wrought Steel Wheels are now available for all classes of service. The process of heat treatment to which these wheels are subjected insures additional service and additional safety out of all proportion to the small increase in cost.

Carnegie Rim-Toughened Wrought Steel Wheels have the stamina to endure the stress and strain of modern high-speed transportation. Carnegie equipped means speed with safety.. means service with economy. Carnegie engineers are at your service at all times.

CARNEGIE
WROUGHT STEEL WHEELS

146

CARNEGIE STEEL COMPANY · PITTSBURGH · PA. Subsidiary of UNITED STATES STEEL CORPORATION

the Committee on Relations between Railroads and Colleges of the Society for the Promotion of Engineering Education. He is a member of the Publication Committee of the American Society of Mechanical Engineers, was formerly chairman of its Meetings and Program Committee, and also headed the committee in charge of its Fiftieth Anniversary celebration in 1930.

WILLIM N. THORNBURGH, president and treasurer of the William N. Thornburgh Manufacturing Company, Cicero, Ill., who died on June 18, had been engaged in railway service and manufacturing for 44 years. He was born at Cleveland, Ohio, on September 15, 1866, and obtained his first railway experience in 1887 as a telegraph operator on the Baltimore & Ohio. Later he served as a chief clerk in the

William N. Thornburgh

traffic department of that railroad, where he remained until he became manager and treasurer of the Thornburgh Coupler & Attachments, Ltd., Detroit, Mich. He then organized the Thornburgh Draft Gear Company, following which he established the William N. Thornburgh Manufacturing Company for the manufacture of dust guards for railroad journal boxes. Mr. Thornburgh's widow, Mrs. M. M. Thornburgh will continue the operation of the company.

RALPH M. HOFFMAN, for eight years manager of the Seattle office of the Pacific division of the Link-Belt Company, has been appointed vice-president and sales manager of that division, with headquarters at San Francisco, Cal. He succeeds Harold H. Clark who retired on June 1.

THE GENERAL MACHINERY CORPORATION, Hamilton, Ohio, has acquired the business of the Putnam Machine Company, Fitchburg, Mass., formerly owned by Manning, Maxwell & Moore, Inc. The Putnam line of products will continue to be manufactured at the General Machinery Corporation's plants as supplementary to the line of The Niles Tool Works Company, another subsidiary of General Machinery Corporation. The company will furnish, and solicits repairs for, all existing Putnam, Dietrich & Harvey, and Beaman & Smith installations. The business will in future be conducted as the Putnam Machine Company, division of General Machinery Corporation. G. A. Rentschler, president of the General Machinery Corporation, is also president of Putnam Machine Company.

CHARLES P. WHITEHEAD, sales assistant to the vice-president and general manager of the General Steel Castings Corporation, Granite City, Ill., has been promoted to manager of sales, with headquarters at Eddystone, Pa. William M. Sheehan, sales assistant to the vice-president and general manager, with headquarters at Eddystone, Pa., has been appointed manager of the Eastern district sales, with the same headquarters. Harry R. Bartell, sales engineer, has been promoted to manager of the Western district sales, with headquarters at Granite City. E. J. Birtwell continues as district manager of miscellaneous sales at Eddystone.

Obituary

H. OTTO WITTPENN, president of the Ardco Manufacturing Company, Hoboken, N. J., died at his home in that city on July 25. Mr. Wittpenn was born on October 21, 1872, at Jersey City, N. J., and was educated in the public schools of that city and schools in Germany. At the time of his death, Mr. Wittpenn was a director of the Morris & Essex Railroad Company and president or a director of several industrial and financial organizations. He had taken an active part in civic affairs, having served as mayor of Jersey City for three terms, and for two terms was comptroller of the Port of New York, under appointment of President Woodrow Wilson. He also served as New Jersey state highway commissioner from 1929 until the time of his death.

Personal Mention

General

R. C. Mohler has been appointed mechanical superintendent of the Southern Persian State Railways, with headquarters at Ahwaz, Persia.

Master Mechanics and Road Foremen

FOLLOWING THE consolidation of the Galveston and Beaumont divisions of the Gulf, Colorado & Santa Fe into one division, known as the Gulf division, C. F. Barnhill, master mechanic of the Beaumont division, has had his jurisdiction extended to include the Galveston division, with headquarters as before at Silsbee, Tex. R. E. Bell, master mechanic of the Galveston division at Galveston, has been assigned to other duties.

Obituary

S. A. WHITEHURST, master mechanic at the Savannah (Ga.) shops of the Central of Georgia, died on June 25 after a long illness. Mr. Whitehurst was born on October 12, 1868. He entered the employ of the Central of Georgia as a machinist in August, 1900, after having served about twelve years with other railroads. In February, 1902, he was appointed enginehouse foreman at Macon, Ga.; in 1905, general foreman at Chattanooga, Tenn.; in 1908, general foreman at Atlanta, and in 1909, master mechanic at Savannah.

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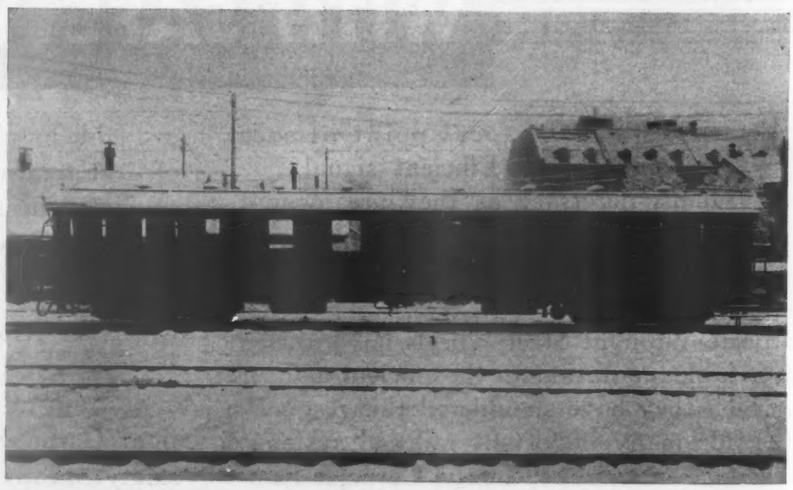

The latest type of second class passenger car to be put in service on the Swiss Federal Railways

This new second class car, entirely constructed of steel and iron, has recently been put in service by the Swiss Federal Railways. It is equipped with triple springs, and in spite of a trial speed of some 65 m.p.h., there was no vibration whatever. The new car is 65.62 ft. long, has 48 seats and weighs 41 tons. It can be heated electrically or with steam and has exceptionally swift-acting brakes. Instead of the customary two seats on each side of the aisle, this car has only three seats: i.e., one seat on one side and two on the other. The interior equipment consists of paneling in dark oak and cherry wood, with plush upholstering in shaded blue. The double ceiling is of a light color, and eight large ventilators provide an abundant circulation of fresh air. Every seat has a 40-watt shaded electric light with individual switch. Two blue lamps function automatically at night. Improved luggage racks are another innovation. It is expected that 18 cars of this latest type, a product of the car and elevator factory at Schlieren, near Zurich, will be put into service this year.

ROLL UP THE MILEAGE

with GOOD BOILER TUBES

Maximum mileage and maximum regularity in proportion to operating costs—that is transportation economy.

Top-notch, unvarying performance of the engine is even more important than economy of boiler maintenance. The two are likely to go together, of course, and NATIONAL-SHELBY Seamless Boiler Tubes go very far to assure both. For the same qualities that make them lasting, make them also highly immune to costly disablements, interruptions, and delays.

Ductility, toughness, and strength are worked into these tubes by employment of the expertness, the facilities, and the organization of the largest manufacturer of tubular products in the world. They resist pitting and fatigue, hold tight in the flue sheet, and give lasting, efficient service. Ask for Bulletin 12, describing NATIONAL-SHELBY—

America's Standard Boiler Tubes

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

US STEEL

NATIONAL SEAMLESS

Trade Publications

Copies of Trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

MOTORS.—Bulletin No. 209, issued by the Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland, Ohio, describes the Type T Reliance motors for direct current.

INSULATING FIREBRICK.—B. & W. No. 80 insulating firebrick for furnace work is the subject of a bulletin issued by the Babcock & Wilcox Company, 85 Liberty street, New York.

WATER GAGES.—A new water gage, the Reliance Micasight, is described in a folder issued by the Reliance Gage Column Company, 5902 Carnegie avenue, Cleveland, Ohio. No glass is used in the design of this gage, the water line being clearly visible through windows of mica.

WRIGHT ELECTRIC HOISTS.—Outstanding features in electric-hoist design are pointed out in an eight-page folder issued by the Wright Manufacturing Company, Bridgeport, Conn. A more complete catalog gives prices and specifications on new Wright electric hoists.

"A SAVING AT EVERY TURN."—This is the title of Book 1293 issued by the Link-Belt Company, 910 South Michigan avenue, Chicago. The book describes the Link-Belt line of positive drives, including silent chain, roller chain, herringbone gears, P. I. V. gear drives, etc., and illustrates many of these positive drive units.

TWO MEN IN A PULLMAN.—This is a small booklet, bound in cardboard, written by Franklin B. Evans for the G. M. Basford Company, 60 East Forty-Second street, New York. It is written in the narrative form of a conversation between two manufacturing executives in the smoking compartment of a Pullman. The subject of the conversation is good and bad advertising.

PUMPS.—A circular, published by the Brown & Sharpe Manufacturing Company, Providence, R. I., lists the complete line of geared, vane and centrifugal pumps which this company manufactures for various pumping requirements, including hydraulically operated machines for supplying liquids under pressure, for circulation, for furnishing coolants to machine tools, etc.

LATHES.—The important units, features and specifications of the new model 9-in. Junior South Bend back-geared screw cutting precision lathe are described and illustrated in Junior catalog No. 22-C issued by the South Bend Lathe Works, South Bend, Ind. These are carried in stock by the A. C. Colby Machinery Company, 183 Centre street, New York, from whom copies of the catalog can also be obtained.

"BOILER WATER CONDITIONING."—This is the title of a new 16-page treatise published by the Elgin Softener Corporation, Elgin, Ill. The book, printed in two colors, discusses various problems in the conditioning of boiler water and is profusely illustrated. There are chapters on Conditioning Boiler Water, Major Problems in the Use of Boiler Water, Chemistry of Boiler Water, Embrittlement, Standard Hook-Ups of Sludge Deconcentrators for Typical Types of Boilers, Continuous Blow Down with Heat Exchanger, etc.

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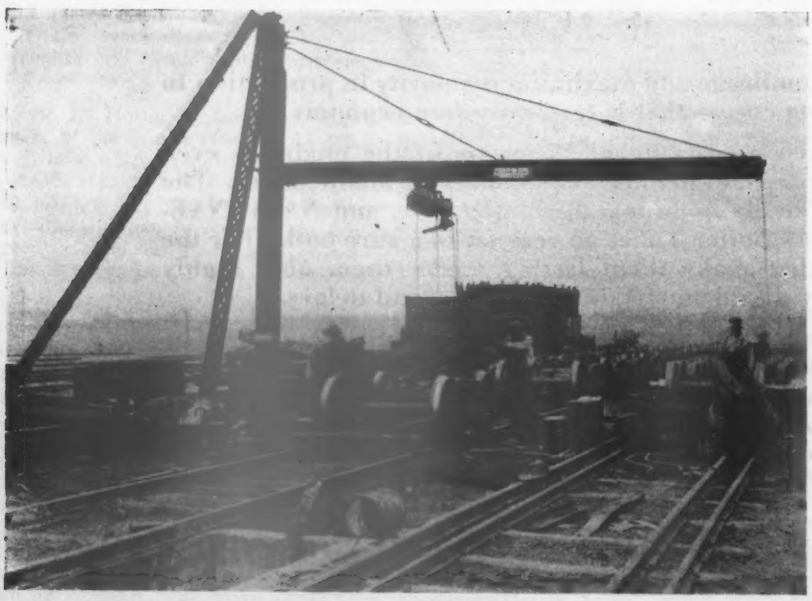

Application of a jib crane and electric hoist for handling truck repairs—Longitudinal concrete pits between the tracks facilitate the application of journal box bolts

Among the Clubs and Associations

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I. — SAFETY SECTION. — J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Carlin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION —Paul D. Mallay, chief engineer, transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

MACHINE SHOP PRACTICE DIVISION. — Carlos de Zafra, care of A. S. M. E., 29 West Thirty-ninth street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—L. H. Morrison, associate editor, Power, 475 Tenth avenue, New York.

FUELS DIVISION.—A. D. Black, associate editor, Power, 475 Tenth avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkless, Room 707, LaSalle Street Station, Chicago. Business session, without exhibit or entertainment, September 15 and 16, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn.

MASTER BOILERMAKER'S ASSOCIATION. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Car Department Officers Association.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National Montreal, Que. William Penn and Fort Pitt Hotels, Pittsburgh, Pa.

RAILWAY BUSINESS ASSOCIATION. — Frank W. Noxon, 1124 Woodward building, Washington, D. C.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SUPPLY MEN'S ASSOCIATION. — E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TRAVELING ENGINEERS' ASSOCIATION. — W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.